1505 East High Street
Jefferson City, Missouri 65101
Telephone (573) 659-9078
Facsimile (573) 659-9079

GREDELL Engineering Resources, Inc.

Spent Blast Media Treatment and Disposal Work Plan
at
W&B of Franklin County (formerly Missouri Green Materials, LLC) 7627 Zero Road, Berger, Missouri

Submitted to:
US EPA Region 7
11201 Renner Blvd
Lenexa, KS 66219

Prepared for:
US Technology Corporation
4200 Munson Street NW
Canton, OH 44718

Prepared by:
GREDELL Engineering Resources, Inc.
1505 E High St
Jefferson City, MO 65101

December 7, 2016

561884

Spent Blast Media Treatment and Disposal Work Plan at W&B of Franklin County (formerly Missouri Green Materials, LLC) 7627 Zero Road, Berger, Missouri

Under Consent Agreement and Final Order

Docket No. RCRA-07-2016-0032

December 7, 2016

Submitted to:

US EPA Region 7

Prepared for:

US Technology Corporation

Prepared by:

GREDELL Engineering Resources, Inc.
1505 East High Street
Jefferson City, Missouri 65101
Phone: (573) 659-9078
Fax: (573) 659-9079
www.ger-inc.biz

Spent Blast Media Treatment and Disposal Work Plan
at
W&B of Franklin County
(formerly Missouri Green Materials, LLC)
7627 Zero Road, Berger, Missouri

Under Consent Agreement and Final Order
Docket No. RCRA-07-2016-0032

Table of Contents

Tables

Figures

Appendices

1.0 Introduction

US Technology Corporation (US Technology) has retained GREDELL Engineering Resources, Inc. (Gredell Engineering) to develop this work plan and other required documents for the stabilization, analytical testing and disposal of spent blast media (SBM). This work plan addresses activities to be performed at the W&B of Franklin County (formerly Missouri Green Materials, LLC (MGM)) site property located at 7627 Zero Road, Berger, in Franklin County, Missouri (Figure 1).

The purpose of this work plan is to attain compliance by preparing the environmental plans and conducting professional environmental services required by the Environmental Protection Agency's (EPA) Region 7 Consent Agreement and Final Order (CA/FO) dated September 21, 2016, Docket No.: RCRA-07-2016-0032. These professional services include ongoing and routine sampling; analysis and documentation during the SBM processing; and final reporting of the stabilization and disposal of SBM currently stored at the W&B of Franklin County (W&B) facility. Gredell Engineering will complete these services in general accordance with the CA/FO and the August 8, 2016 Offer to Compromise Pursuant to R. 408 and Stabilization Plan prepared by Mills, Mills, Fiely & Lucas on behalf of US Technology. The proposed work will be completed by US Technology, as the contractor, and their subcontractors, while Gredell Engineering will fulfill the duties of the project manager and the engineering firm of record, in general accordance with the CA/FO.

As a part of the resolution of the disposition of SBM stored at the W&B facility, approximately 6,500 tons of recovered SBM impacted with cadmium, chromium and lead is currently stored in super sacks and drums and are proposed to be treated and stabilized on site with Portland cement and disposed at an MDNR approved Subtitle D landfill facility.

This work plan addresses the process, equipment and procedures, quality assurance, health and safety, sampling and testing methods for treating and stabilizing the SBM by adding the appropriate amount of Portland cement and water for hydration to meet the 40 CFR Part 268 Land Disposal Restrictions (LDR) prior to disposal. The treated SBM will be stored in stockpiles while the Portland cement is allowed to hydrate and stabilize the SBM contaminants of concern. Representative composite samples will be collected from each stockpile and submitted for analysis to PDC Laboratories, Inc. (PDC) in St. Louis, Missouri to confirm the success of on-site treatment. Once test results are received that a stockpile meets the LDR and landfill's disposal criteria, that stockpile will be loaded on to dump trucks and transported to the approved facility for disposal.

2.0 Background

US Technology provided bead blast material to a customer to strip paint from airplanes, vehicles and equipment. Such use can result in toxic levels of metals (e.g., cadmium and chromium) to accumulate in the SBM. Beginning in or around 2000, US Technology shipped SBM to a company called Hydromex for recycling. Instead of recycling the SBM, Hydromex buried SBM at its facility in Yazoo City, Mississippi, resulting in an investigation by the Mississippi Department of Environment Quality (MDEQ).

In December 2013, the MDEQ notified the Missouri Department of Natural Resources (MDNR) that numerous shipments of SBM from the Hydromex facility had been shipped to Missouri Green Materials, LLC (MGM) facility in Berger, Missouri. In addition, the MDNR learned that US Technology had shipped SBM from some of its other facilities to the MGM facility between at least October 24, 2013 and December 31, 2013.

MDNR personnel inspected the MGM facility on December 13, 2013. The inspection revealed that US Technology was storing large quantities of SBM in super sack containers and 55-gallon drums inside the MGM facility. The EPA conducted sampling of the SBM at the MGM facility on June 3 through 6, 2014. The results of this sampling confirmed that US Technology was storing hazardous waste at the MGM facility, as 77% of the samples analyzed failed the Toxicity Characteristic Leaching Test (TCLP) for cadmium and/or chromium.

3.0 Site Description

The W&B facility was previously a manufacturing facility located on approximately 21 acres of ground located in Section 34, T46N, R04W, west of the town of Berger, Franklin County, Missouri (Figure 1). The physical site address is 7627 Zero Road, Berger, Missouri, 63014. The northern side of the site is bordered by agricultural wooded properties and the Union Pacific Rail Road to the extreme north. The eastern and western sides of the property are bordered by agricultural properties and a few residential homes. The southern side is bordered by Zero Road (paved), Little Berger Creek and agricultural property, and access to the site is attained by the use of gravel driveways off of Zero Road.

The site is located in the Ozark Plateau Physiographic Province. The local topography is relatively flat with a gentle slope to the south towards Little Berger Creek. Ground surface elevation is approximately 515 feet above mean sea level, and the facility is approximately 2,000 feet south of the Missouri River. According to information obtained from the MDNR GeoSTRAT web-based program and private well drilling log information, alluvial soils attain an approximate thickness of 90 feet and the uppermost bedrock consists of the Jefferson City Dolomite.

The site facility (building) was constructed around 1970 for Zero Manufacturing, a manufacturer of industrial tanks (Figure 2). In 1998, the building was occupied by Gencorp Automotive who processed rubber compounds into automotive sealing products. MGM leased and co-operated within the facility, thereafter. The main facility is currently an 110,000 square feet industrial warehouse, which includes 12,000 square feet of lower-level and Mezzanine office space, and five truck loading docks. Other site appurtenances include an inoperable two-cell wastewater lagoon; inoperable private water well, well house and water storage tower; attached utility building (i.e., previous compressor storage) and adjacent electrical substation; and a detached open-air outbuilding. The entire floor of the building is constructed with six-inch reinforced concrete, and all loading docks and garage entryways and their immediately surrounding areas are also paved with concrete.

4.0 Background Sampling and Field Screening

Prior to the treatment and disposal process operations, representative surface soil samples will be collected around the facility to establish background soil concentrations of cadmium, chromium and lead. The soil sampling locations are proposed as shown in Figure 2, and will be collected from the four sides of the facility and along the gravel driveways. Soil samples will be collected from at grade to six-inches in depth. The proposed soil sample locations may be field screened using an XRF (X-Ray Fluorescence) analyzer prior to sample collection per the MDNR Quality Assurance Project Plan and Addendum for Brownfields/Voluntary Cleanup Program Sites (QAPP) (Appendix 1).

The soil samples will be collected, containerized, preserved and shipped in accordance with the QAPP and EPA protocol for soil samples to be tested for metals. The samples will be analyzed via EPA Test Method 6010 for lead, cadmium, and chromium. The results will be used to compare to concentrations of soil samples collected after the completion of the treatment and disposal process.

Representative background surface samples will be collected within the building prior to the treatment and disposal process operations. Samples (e.g., wipe or prepared filter analysis) will be collected from surfaces within the building, however, these surfaces may be analyzed using an XRF (X-Ray Fluorescence) analyzer to field screen for SBM residues. US Technology proposes to sample and/or XRF analyze every 1,000 square feet of available floor space within the facility that is void of SBM storage. US Technology proposes a maximum of 10 wipe or prepared filter samples collected from within the facility and analyzed via EPA Method 6010. The results will be used to compare to concentrations of surface samples collected after the completion of the treatment and disposal process.

5.0 Toxicity Characteristics and Universal Treatment Standards

The EPA's analytical results of the samples collected in June 2014 from the SBM indicate the TCLP values exceeded the LDR toxicity characteristic (TC) for cadmium and chromium at one milligram per liter (mg/L) and five mg/L, respectively. These TC exceedances prevent the disposal of the untreated SBM into a Subtitle D landfill, and therefore, the SBM must be treated and stabilized at or below the EPA's universal treatment standards (UTSs) prior to disposal. Representative composite samples will be collected from each stockpile of processed SBM and submitted to PDC for analysis of cadmium, chromium and lead to confirm the success of treatment and stabilization. Once analytical results confirm a stockpile meets the LDR UTSs, as provided in the table below, the results will be provided to the EPA and/or MDNR for approval of the stockpile's disposal.

Constituent	Toxicity Characteristic as TCLP (mg/L)	Universal Treatment Standard as TCLP (mg/L)
Cadmium	1	0.11
Chromium	5	0.60
Lead	5	0.75

6.0 Permitting

Gredell Engineering will prepare, communicate and coordinate the necessary permitting or exemption requests with local, state and federal agencies, which may include, but are not limited to air pollution emissions; special waste disposal requests; and the Unified Land-Use Regulations of Franklin County Planning and Zoning. It is the understanding of US Technology that the SBM stabilization process will not be subject to RCRA permitting requirements as a treatment, storage and disposal (TSD) facility, and therefore, a TSD permit will not be required.

7.0 Mobilization and Equipment Staging

US Technology will mobilize a team of personnel to prepare the site for processing activities. Activities will include establishing work areas, installation of the processing area, and temporary facilities. Some of the currently placed SBM (Figure 3) will be temporarily relocated within the building for the installation of the processing area (Figure 4).

Following approval of the required project plans and necessary permits, US Technology will begin assembling equipment, materials, and supplies that will be required for shipment to the site. A progressive shipment scheme for items will be used, with equipment shipped as needed for the activities planned. The intent of this scheme is to minimize the accumulation of unnecessary material and equipment at the site, thus eliminating congestion that may adversely slow the mobilization process.

Equipment will include, but is not limited to, the following:

- Forklift – propane, with barrel dumper
- Cement truck – diesel

- Three 5-Horsepower screw conveyor augers, 6-inch diameter x 20 foot length
- Receiver hopper
- Cartridge dust collectors
- Barrel unloader station with dust control
- Super sack holder extension and loading station
- Backhoe
- Front-end loader
- Timbers (12-inch x12-inch) for stockpile partitions
- Concrete Jersey barriers or super blocks for stockpile outer/bunker walls
- 500 gallon water tanker, 100 gallon water staging tank
- 200 gallon cleaning water holding/recovery tank
- 10 staging area daily lot signs
- Dump trucks
- Scale for weighing SBM and/or Portland cement

8.0 Treatment and Stabilization Plan

Treatment and stabilization of the 6,500 tons of the recovered SBM will be accomplished by adding Portland cement by volume ratio basis and blending it thoroughly with the SBM, then adding a water to cement ratio in order to sufficiently hydrate the cement and stabilize the SBM to meet the LDR criteria for cadmium, chromium and lead. The sufficiency of the treatment will be verified through sample collection by Gredell Engineering and subsequent TCLP analysis by PDC. The treated SBM will be stored in stockpiles up to 120 cubic yards in size within the secured W&B facility to allow the cement to chemically react with the SBM. Samples will be collected from each stockpile per the plan below and submitted to PDC for analysis. Once test results confirm that a stockpile meets the LDR criteria, and approval from the EPA and/or MDNR is granted, that stockpile will be loaded onto dump trucks inside the building and transported to the approved landfill for disposal.

Treatment will be completed inside the existing building and performed in batches to ensure a thorough mixing of the Portland cement with the recovered SBM. Each batch will consist of approximately 12,000 pounds of recovered SBM, 1,500 pounds of Portland cement, and 54 gallons of water. Treatability testing previously conducted by US Technology indicates that this ratio of cement/water to SBM will meet the LDR criteria, however, this ratio may be altered during the treatment process if actual field testing indicates differently. According to Treval Powers, "Non-evaporable water content of hardened Portland cement paste", Portland cement requires a minimum 26% of its weight in water to be fully hydrated. Due to losses in the mixing process and the large amount of particulate to be wetted, and to insure complete hydration, US Technology will add 40% water/cement or approximately 96 gallons of water for each 2,000 pounds of cement (Table 1). The batches will be mixed by way of a super sack-receiving hopper with dust control mechanisms, a dust-controlled barrel dumping station, closed-tube augers, cement mixing truck with a nine-cubic yard capacity, and then placed into the timber-partitioned bunks within the stockpile area. A drawing of the SBM process diagram is included as Figure 5.

Prior to the batch mixing, US Technology will document the SBM identification numbers (ID #'s) located on each super sack and drum that will be added to each batch. These ID #'s also include the weight of each super sack or drum, which will be recorded on the Batch Log (Appendix 2) to verify their dispositions and volume of Portland cement and water required for the batch.

A forklift will be used to lift the super sacks and drums of SBM over the receiver hopper or into the drum tipper to add the SBM to the truck-mounted cement mixer. Likewise, a forklift will be used to add the super sacks of Portland cement to the receiver hopper. Once the appropriate volume of Portland cement is blended into the mixer, the required amount of water will be added to complete the batch. The batch will blended in the cement mixer to the required consistency. Once a batch is completed, the actual quantities of Portland cement and water used will be recorded. The cement mixing truck will be driven to the daily production stockpile area and each batch will be poured onto the lubricated (e.g., vegetable oil) concrete floor inside the bunk partitions for stabilization. US Technology estimates the production of nine batches per day, whereas nine batches will equal one lot.

Each lot will be given a unique number and visible numbered flags will be used to identify the respective batches, and will be recorded on the Daily Production Log (Appendix 3). Each lot will remain segregated within the storage bunks from the other lots until disposal. This will be achieved by building partitions between the lots to prevent migration of treated SBM from one lot to another. Up to ten of these storage bunks will be created within the stockpile designated area inside the existing building. The maximum stockpile size will be 120 cubic yards to simplify sample collection.

It is noted the SBM stabilization process will not generate wastewater at the W&B facility, and therefore, wastewater discharges to the existing two-cell lagoon and site property will not occur. Additionally, water used for the stabilization process will be hauled to the site, as the on-site water well and distribution network is inoperable.

9.0 Treated SBM Verification Sampling

Each stockpile will be allowed to cure for a minimum of 48 hours before samples are collected to allow the Portland cement time to hydrate. A representative, composite sample will be composed of five sub-samples collected randomly from the stockpile. The stockpile will divided into a 24 square yard grid pattern. A sub-sample will be randomly collected in each grid. The sub-samples will be placed in a pre-cleaned, stainless steel mixing bowl and thoroughly mixed using a pre-cleaned, stainless steel scoop until well homogenized. A duplicate sample will be collected from every group of ten composite samples. US Technology estimates that 110 samples of treated SBM will be collected during the stabilization process, which includes a 20 percent retesting rate due to analytical exceedances and one duplicate sample for every ten samples collected. Split-sampling of treated SBM by the EPA and/or MDNR will be coordinated with US Technology and Gredell Engineering upon their request.

The treated SBM samples will be collected under the direction and observation of Gredell Engineering, documented on the TCLP Results Log (Appendix 4), and submitted to PDC for the TCLP analysis of cadmium, chromium and lead per EPA Test Method 1311. Samples will be shipped overnight under a complete chain of custody form with a requested turn-around-time of 5 working days.

10.0 Disposal Plan

Once analytical results have been received, indicating that a stockpile has met the LDR criteria, that stockpile will be loaded into dump trucks using a front-end loader from inside the building, covered with the truck tarp per United States Department of Transportation (US DOT) and Missouri Department of Transportation (MoDOT) requirements, and transported to the selected Subtitle D facility approved by the EPA and/or MDNR. Each truckload of treated SBM will be logged on the example Bill of Lading/Shipping Manifest (Appendix 5) before leaving the project site. A copy of the Batch Log, Daily Production Log, TCLP Results Log, Bill of Lading, and landfill receipt will be retained for incorporation into the final report.

11.0 Meetings and Monthly Reporting

During processing, Gredell Engineering, US Technology and the processing staff will hold bi-weekly (twice per week) meetings at the facility to discuss sampling and quality control observation activities; evaluate the treatment process; verification sampling methods and results; health and safety; SBM inventory (treated, untreated, and disposed); analytical results; and the review of generated shipping documents, and landfill disposal receipts.

At the beginning of each month, a summary report will be provided to the EPA and/or MDNR outlining the previous month's activity. The report will include the monthly and cumulative amount of treated SBM and the monthly and cumulative amount of treated SBM disposed, along with the TCLP analytical results. Landfill disposal receipts will be provided to the EPA's and/or MDNR's upon request.

12.0 Work Plan Timeline

The described work plan is projected to treat/stabilize 60 tons per day of recovered SBM. US Technology estimates 1,100 batches of treated SBM will be processed at a target processing rate of nine batches per day. With 6,500 tons of recovered SBM to treat, this yields approximately 22 weeks (109 operational days) of continual processing, at a minimum (Table 1).

An initial eight weeks for mobilization, project site preparation and processing equipment setup will be required, and a one-week ramp-up schedule will be required. The first stockpile of treated SBM will be hauled to the landfill approximately 12 weeks after official approval of this work plan. The last truckload of treated SBM will be hauled to the landfill approximately one week after processing is complete. Once completed, two weeks will be required to remove equipment and decontaminate the site. The total estimated time to complete the treatment and disposal process is 33 weeks.

Although the mixing process will occur inside the facility, weather will still play a key role in this plan. Heavy rain will prevent US Technology from hauling treated SBM to the landfill for disposal, and cold weather conditions will inhibit hydration and set up of materials. It is noted that Portland cement will not react below 40 degrees Fahrenheit, and therefore, the treatment process activities will halt at or below this temperature, as the facility is not heated. For this reason, US Technology proposes a processing startup date of April 2017.

13.0 Quality Assurance – Process Control

Utilization of a standardized batch process promotes the consistency for the SBM metals stabilization. The volume of SBM to the Portland cement/water mixture is projected to be incorporated similarly in each batch. A Batch Log (Appendix 2) will be utilized to record the mixture ratio (i.e., six SBM super sacks to one Portland cement super sack). The super sacks will be staged and recorded prior to introduction into the receiver hopper. Batch logs will be coded with the date and sequential batch number (e.g., as 4-17-17-3), where '4-17-17' is the date and '3' is the batch number. These accumulate to the 4-17-17 lot, which will be associated to the representative sample and TCLP analytical result. The compiled log will list the disposition of the daily lots, and other relevant information such as weather issues.

The Gredell Engineering Project Manager or designee is responsible for ensuring that samples are collected, preserved, and recorded properly. The work plan activities will be performed in general accordance with the QAPP (Appendix 1). The laboratory quality assurance manager is responsible for laboratory procedures, calculations and all lab-related quality control activities in accordance with the PDC Quality Assurance Plan, which is provided as an attachment in the QAPP.

14.0 Health and Safety

A site-specific Health and Safety Plan (HASP) has been developed that addresses applicable safety precautions associated with this project. The safety precautions detailed in the site-specific HASP will be followed during site activities.

A written daily tailgate safety meeting form and daily safety record will be implemented and maintained by the on-site US Technology representative or their designee to record and document persons working at and visiting the site during the processing work period. The processing and work loading areas will be clearly identified at the site and segregated from the rest of the building during the treatment and disposal activities. Access inside the building will be limited to processing workers, truck drivers and related observers and visitors needing to document relevant activities associated with the work.

Management of the treated SBM and subsequently sample collection will be supervised by the Gredell Engineering CA/FO Project Manager or designee, whereas the machinery, processing and equipment worker training will be supervised by US Technology or their subcontractors. The SBM is reported to be impacted with lead, cadmium, and chromium and these metals will be the primary contaminants of concern for worker exposure. Biological concerns associated with insects, and rodent and bird droppings, will also be evaluated.

The proposed treatment and disposal process will be completed by experienced US Technology employees or their subcontractors, and they will be made aware of the hazards of exposure to these metals and other safety concerns during their review and signature of the HASP. The process treatment and loading workers will be exposed to dust during the treatment process. However, the process will include a water system which can supply water to spray dampen the materials for dust control, if required. Dust control inside the building will also be controlled by commercial dust collection cartridge filters. It is presumed that there will be a need for respiratory protection for SBM impacted dust; however, ambient air monitoring will not be conducted. Process workers will also be supplied with 3-micron dust masks and positive air purifying respirators (PAPR) and air-supplied high-efficiency particulate air (HEPA) filter helmets. Dust recovered will be returned to the treatment process.

Workers and observers within the facility will be encouraged to don Level C PPE during the SBM processing and loading activities. Process PPE may consist of work clothes, protective coveralls (e.g, Tyvek suit), respirators, dust masks, gloves, safety glasses, steel toed work boots, boot covers and a hard hat. Highly visible colored safety vest should be worn by those on site during processing and disposal activities.

Other site safety and health hazards to workers and observers are the physical hazards associated with the processing site. Workers and observers should be wary of slip, trip and fall hazards on the site work area. Additionally, the equipment (excavator, loader, trucks, etc.) should have audible backup warning devices and fire extinguishers. Workers and observers on site will be verbally advised and warned to stay clear of operating equipment performing processing and loading activities.

During the processing activities, US Technology and their subcontractors will be encouraged to evaluate oxygen-deficient atmospheres that may be at levels that pose a health threat to on-site workers and observers. Exact monitoring locations and time periods will be determined in the field, based on the judgment of US Technology and/or their subcontractors. Real-time air monitoring for carbon monoxide, as a result of the processing equipment and dump trucks, may be met by installing carbon monoxide detectors in the SBM processing, stockpile and loading areas.

Processing work in the summer months may create heat stress conditions for the process workers inside the facility. The use of respiratory protective equipment and protective (non-breathable) clothing, boots, and gloves can greatly increase the potential for heat stress. Site workers will regularly monitor the condition of the work force for signs of heat stress. Heat stress monitoring and modified work-rest schedules will be as required.

In order to provide safe and efficient work conditions, work areas should be kept clean and free of debris. Potable water will be used for first aid, drinking, and personal hygiene purposes. Portable toilets will be provided on site, a minimum of one toilet for each 15 employees, and will be maintained on a weekly basis.

Designated areas will be established on site for worker breaks and smoking. No smoking, eating or gum chewing will be allowed in the processing, stockpile and loading areas. Exclusion, contamination reduction and support zones will be established on site in accordance with the HASP.

15.0 Site Restoration, Post-Processing Sampling and Field Screening

Site restoration and cleanup activities will be conducted to verify that regulated quantities or residues of SBM do not remain at the facility after the completion of the processing and disposal activities. This will require the removal of SBM, debris or other impacted media and/or material as necessary to demonstrate that the regulated quantities of SBM have been removed from the affected parts of the facility.

Representative surface samples will be collected within the building after the treatment and disposal process operations. Samples (e.g., wipe or prepared filter analysis) will be collected from surfaces within the building, however, these surfaces may be analyzed using an XRF (X-Ray Fluorescence) analyzer to field screen for SBM residues. US Technology proposes to sample and/or XRF analyze every 1,000 square feet of floor space within the facility that was impacted by the SBM storage and processing activities. US Technology proposes a maximum of 50 wipe or prepared filter samples collected from within the facility and analyzed via EPA Method 6010. The surface sample results will be used to compare to concentrations of cadmium chromium and lead found in background surface samples collected prior to the start of SBM treatment and disposal process.

Post-processing soil samples will be collected from outside the facility in the areas of previous background sample locations and in the areas of the treated SBM transport (i.e., gravel driveways) on the facility property. The soil sample results will be used to compare to concentrations of cadmium, chromium and lead in background soil samples collected prior to the of the treatment and disposal process.

Should analytical results indicate an impact has occurred due to the processing and disposal activities, a separate remediation work plan to address the impacted areas will be provided to EPA and/or MDNR under separate cover, upon their request.

16.0 Demobilization

Upon confirmation that cleanup criteria have been achieved and completion of decontamination activities, the processing equipment installed by US Technology will be dismantled and removed from the site. The processing debris, including empty drums and super sacks generated by US Technology, will be removed from the site for proper disposal or recycling.

17.0 Final Report

A final report will be prepared and submitted to the EPA and/or MDNR following completion of the processing, site restoration and demobilization activities in general accordance with the CA/FO. The report will include a written narrative; necessary tables, figures and photographs; copies of SBM sample analytical results; background and post-process sample analytical results; shipping documents for the treated SBM; logs and measurements for the treatment of the SBM indicating the weights and volumes of SBM, Portland cement and water used during treatment; and other documentation generated as a result of the implementation of the approved work plan.

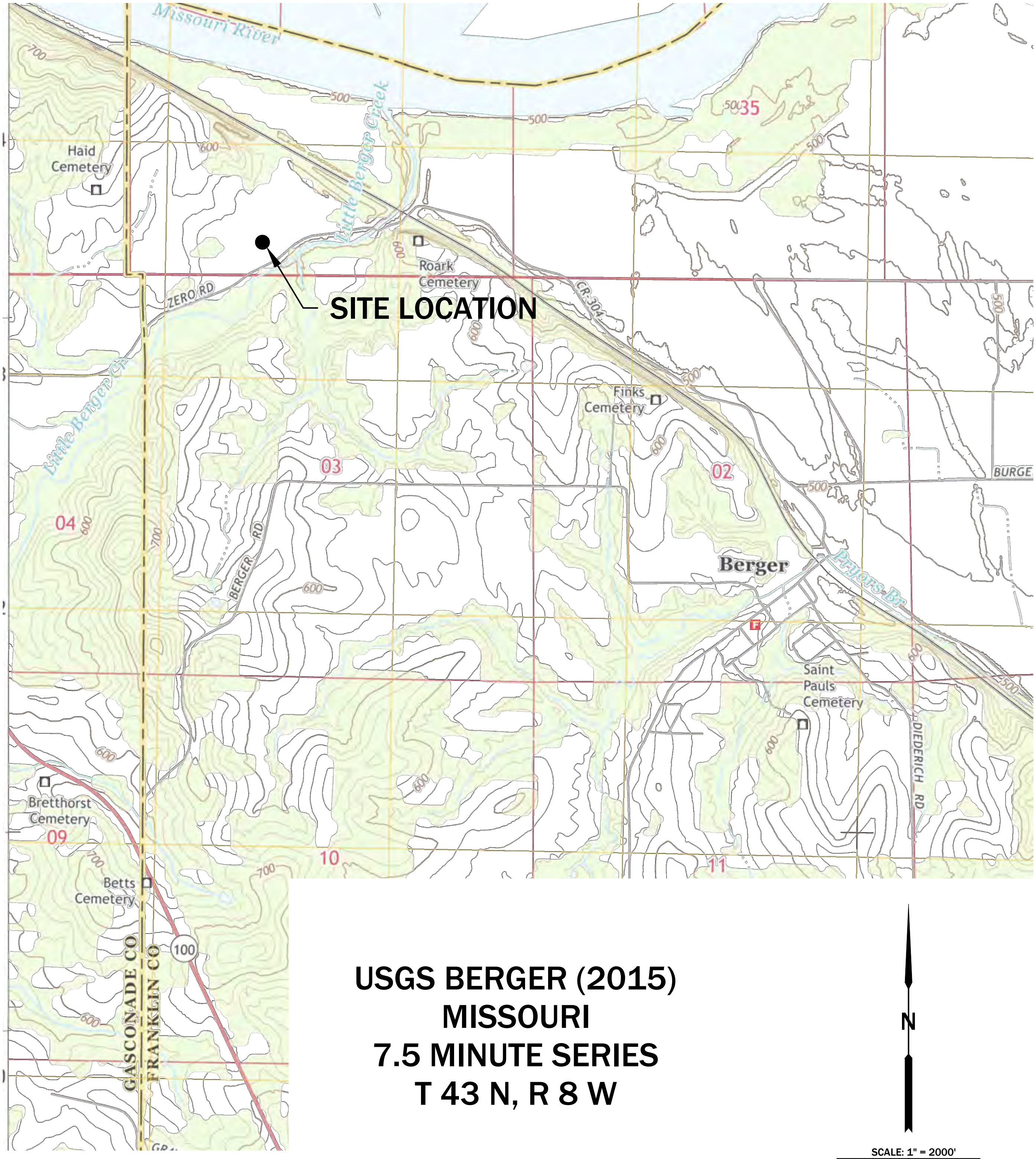
TABLES

Spent Blast Media Treatment and Disposal Work Plan
at
W&B of Franklin County
(formerly Missouri Green Materials, LLC)
7627 Zero Road, Berger, Missouri

Table 1 - SBM Treatment and Process Calcuations

KNOWNS							
1 gallon water	62.4	pounds per cubic feet (lbs/cf)					
1 gallon water	8.34	lbs					
1 cubic yard (cy)	27	cf					
1 ton	2000	lbs					
SBM on site	6,500	tons	13,000,000 lbs				
1 treated batch	9	cy (20'x30'x1' bunk dimension)					
Max. stockpile size	120	cy	Collect one composite TCLP sample per stockpile				
1 cf sack Portland cement	94	lbs/cf					
US TechPolyplus Media	58	lbs/cf	Ranges 58-60 lbs/cf pre-SBM				
PROCESS	1.0	gallon of water per	28	lbs of Portland			
	53.6	gallons of water per 1,500 lbs of Portland					
	446.6	pounds of water per batch					
ONE BATCH	12,000	lbs SBM	206.90	cf	7.66	cy	
	1,500	lbs Portland	15.96	cf	0.59	cy	
	446.6	lbs water	7.16	cf	0.27	cy	
TOTALS	13,947	lbs/batch	230.01	cf	8.52	cy	
or	6.97	tons/batch			9	cy	Round to 9 cy
	1083.3	batches required based on 12,000 lbs of SBM/batch					
use	1100	batches					
TCLP SAMPLES	13.3	batches per stockpile using 9 cy per batch					
	9750	cy using 9 cy per batch					
	81.3	samples required using 9 cy per batch					
	97.5	samples if using a 20% retesting rate due to analytical exceedances					
	9.8	duplicate samples at 1 duplicate sample per every 10 samples collected					
	107.3	estimated Total of SBM Samples					
TREATED SBM PER DAY							
Estimate/day	60	tons of treatmed SBM					
	8.6	batches per day					
	108.3	days to process 6,500 tons @ 60 tons/day					
	21.7	weeks to process 6,500 tons @ 5 days/week					
	8	weeks for startup					
	1	week for hauling/disposl of last load of treated SBM					
	2	weeks for teardown					
	32.7	weeks estimated time to complete processing & teardown					

FIGURES



USGS BERGER (2015)
MISSOURI
7.5 MINUTE SERIES
T 43 N, R 8 W

SBM TREATMENT & DISPOSAL WORK PLAN W&B OF FRANKLIN COUNTY 7627 ZERO RD, BERGER, MO US TECHNOLOGY CORPORATION	GREDELL Engineering Resources, Inc. ENVIRONMENTAL ENGINEERING LAND - AIR - WATER 1505 East High Street, Jefferson City, Missouri Telephone: (573) 659-9078 Facsimile: (573) 659-9079 MO CORP. ENGINEERING LICENSE NO. E-2001001669-D

FIGURE 1 - SITE LOCATION MAP	DATE	SCALE	PROJECT NAME	REVISION
	12/2016	AS NOTED	USTECHNOLGY	
	DRAWN	APPROVED	FILE NAME	SHEET #
	AJK	TD	TREATMENT DISPOSAL	1 OF 1

M:\Share\CADDFiles\USTechnology\TREATMENT DISPOSAL.dwg, FIGURE 1 - SITE LOCATION MAP, 12/5/2016 1:26:50 PM

LEGEND

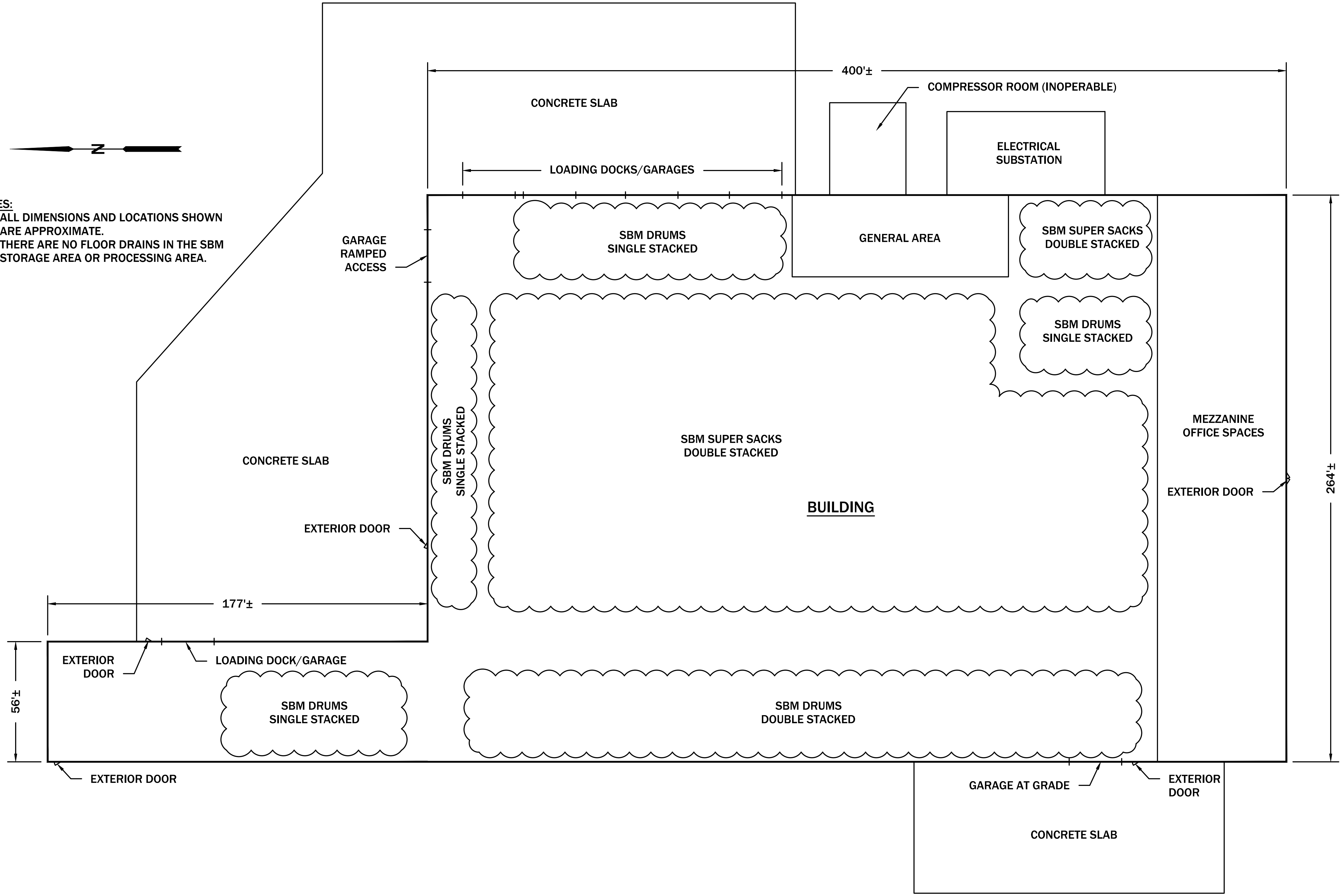
PROPOSED BACKGROUND SOIL SAMPLE LOCATIONS (10) ⊕

NOTES:

1. BACKGROUND IMAGE PROVIDED BY BING MAPS.

SBM TREATMENT & DISPOSAL WORK PLAN W&B OF FRANKLIN COUNTY 7627 ZERO RD, BERGER, MO US TECHNOLOGY CORPORATION	GREDELL Engineering Resources, Inc. ENVIRONMENTAL ENGINEERING LAND - AIR - WATER 1505 East High Street Telephone: (573) 659-9078 Jefferson City, Missouri Facsimile: (573) 659-9079 MO CORP. ENGINEERING LICENSE NO. E-2001001669-D			
FIGURE 2 - SITE LAYOUT	DATE 12/2016	SCALE AS NOTED	PROJECT NAME USTECHNOLGY	REVISION
	DRAWN AJK	APPROVED TD	FILE NAME TREATMENT DISPOSAL	SHEET # 1 OF 1

M:\Share\CADDFiles\USTechnology\TREATMENT DISPOSAL.dwg, FIGURE 2 - SITE LAYOUT, 12/5/2016 1:26:56 PM



NOTES:

1. ALL DIMENSIONS AND LOCATIONS SHOWN ARE APPROXIMATE.
2. THERE ARE NO FLOOR DRAINS IN THE SBM STORAGE AREA OR PROCESSING AREA.

#	DATE	REVISION DESCRIPTION	BY

FIGURE 3 - BUILDING LAYOUT (EXISTING)
SBM TREATMENT & DISPOSAL WORK PLAN

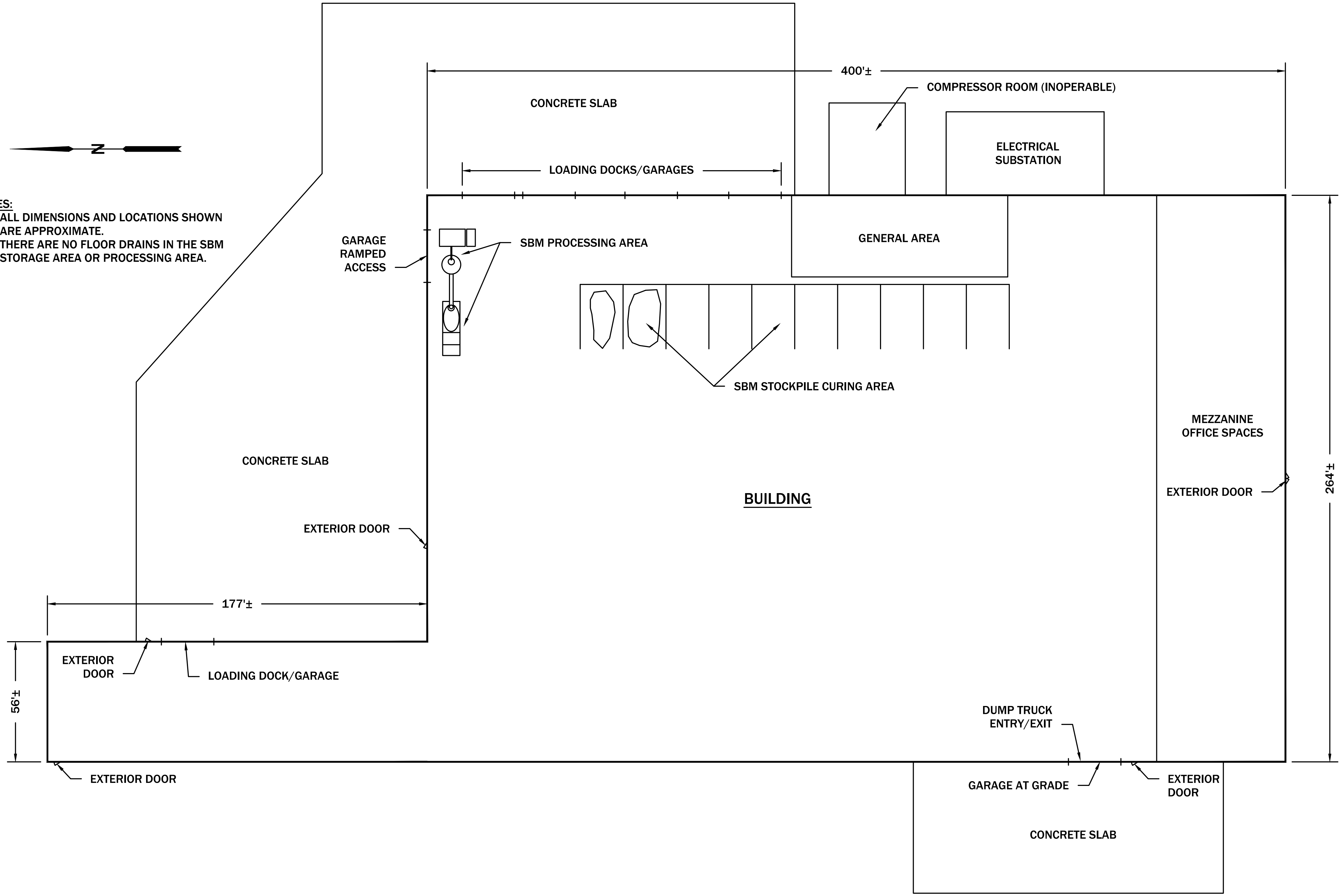
W&B OF FRANKLIN COUNTY
7627 ZERO RD, BERGER, MO
US TECHNOLOGY CORPORATION

SURVEYED	DESIGNED	DRAWN	CHECKED	APPROVED	DATE	SCALE	PROJECT NAME	FILE NAME	SHEET #
NA	NA	AJK	TD	TD	12/2016	N.T.S.	USTECHNOLOGY	TREATMENT DISPOSAL	1 OF 1

GREDELL Engineering Resources, Inc.
ENVIRONMENTAL ENGINEERING LAND - AIR - WATER
1505 East High Street
Jefferson City, Missouri
Telephone: (573) 659-9078
Facsimile: (573) 659-9079
MO CORP. ENGINEERING LICENSE NO. E-2001001669-D

M:\Share\CADDFiles\USTechnology\TREATMENT DISPOSAL.dwg, FIGURE 3 - BUILDING LAYOUT (EXISTING), 12/5/2016 1:26:57 PM

NOTES:
1. ALL DIMENSIONS AND LOCATIONS SHOWN ARE APPROXIMATE.
2. THERE ARE NO FLOOR DRAINS IN THE SBM STORAGE AREA OR PROCESSING AREA.



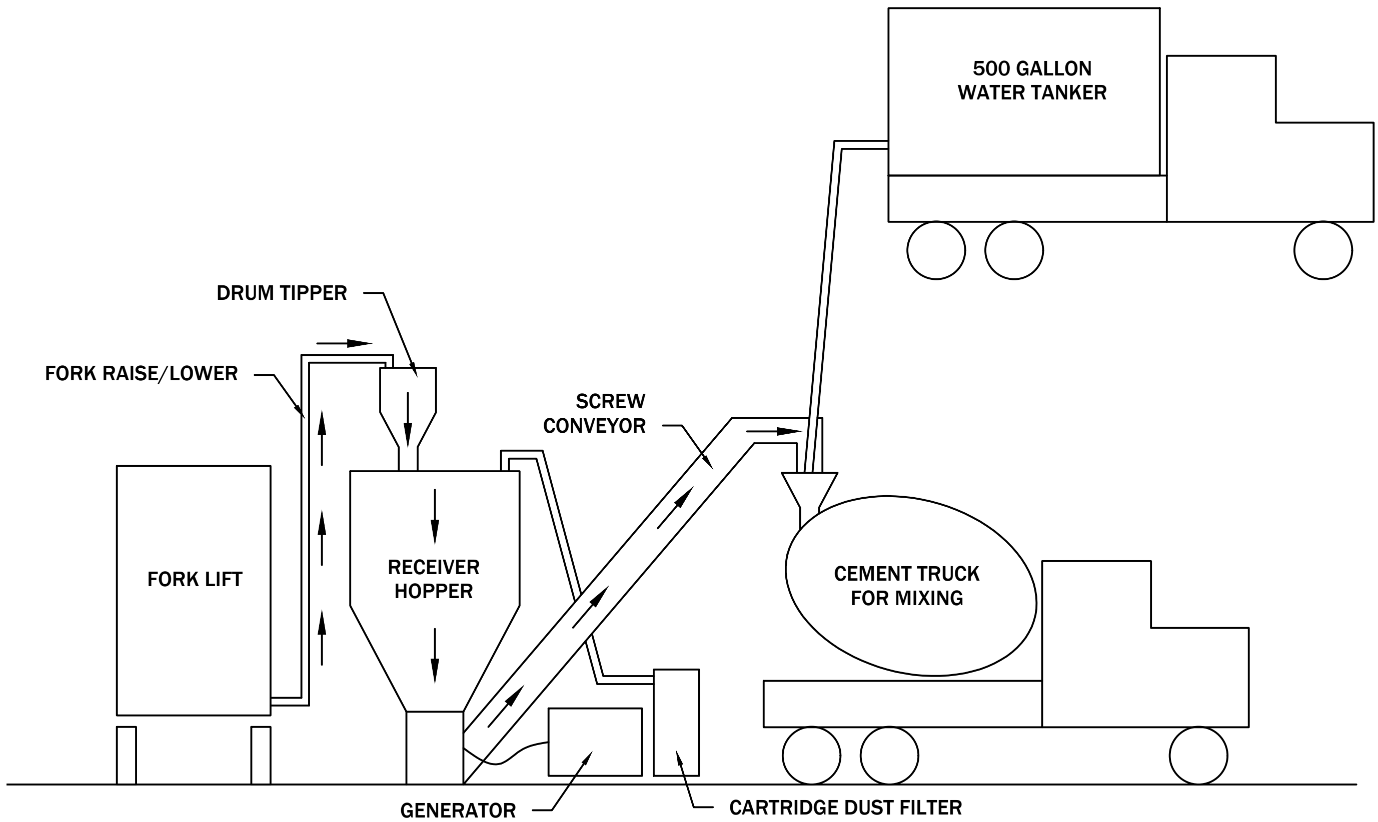
#	DATE	REVISION DESCRIPTION	BY

FIGURE 4 - BUILDING LAYOUT (DURING TREATMENT)
SBM TREATMENT & DISPOSAL WORK PLAN

W&B OF FRANKLIN COUNTY
7627 ZERO RD, BERGER, MO
US TECHNOLOGY CORPORATION

SURVEYED	DESIGNED	DRAWN	CHECKED	APPROVED	DATE	SCALE	PROJECT NAME	FILE NAME	SHEET #
NA	NA	AJK	TD	TD	12/2016	N.T.S.	USTECHNOLOGY	TREATMENT DISPOSAL	1 OF 1

GREDELL Engineering Resources, Inc.
ENVIRONMENTAL ENGINEERING LAND - AIR - WATER
1505 East High Street
Jefferson City, Missouri
Telephone: (573) 659-9078
Facsimile: (573) 659-9079
MO CORP. ENGINEERING LICENSE NO. E-2001001669-D



SBM TREATMENT & DISPOSAL WORK PLAN
W&B OF FRANKLIN COUNTY
7627 ZERO RD, BERGER, MO
US TECHNOLOGY CORPORATION

GREDELL Engineering Resources, Inc.
ENVIRONMENTAL ENGINEERING LAND - AIR - WATER
1505 East High Street Telephone: (573) 659-9078
Jefferson City, Missouri Facsimile: (573) 659-9079
MO CORP. ENGINEERING LICENSE NO. E-2001001669-D

FIGURE 5 - SBM PROCESS DIAGRAM	DATE 12/2016	SCALE AS NOTED	PROJECT NAME USTECHNOLGY	REVISION
	DRAWN AJK	APPROVED TD	FILE NAME TREATMENT DISPOSAL	SHEET # 1 OF 1

M:\Share\CADDFiles\USTechnology\TREATMENT DISPOSAL.dwg, FIGURE 5 - SBM PROCESS DIAGRAM, 12/5/2016 1:26:57 PM

APPENDICES

APPENDIX 1

MDNR Quality Assurance Project Plan and Addendum for Brownfields/Voluntary Cleanup Program Sites

1505 East High Street
Jefferson City, Missouri 65101
Telephone (573) 659-9078
Facsimile (573) 659-9079

GREDELL Engineering Resources, Inc.

QUALITY ASSURANCE PROJECT PLAN
for
Spent Blast Media Treatment and Disposal Work Plan
at
W&B of Franklin County (formerly Missouri Green Materials, LLC) 7627 Zero Road, Berger, Missouri

Submitted to:
US EPA Region 7
11201 Renner Blvd
Lenexa, KS 66219

Prepared for:
US Technology Corporation
4200 Munson Street NW
Canton, OH 44718

Prepared by:
GREDELL Engineering Resources, Inc.
1505 E High St
Jefferson City, MO 65101

December 7, 2016

MISSOURI DEPARTMENT OF NATURAL RESOURCES
AIR AND LAND PROTECTION DIVISION
HAZARDOUS WASTE PROGRAM
BROWNFIELDS/VOLUNTARY CLEANUP PROGRAM (BVCP)
SITE-SPECIFIC QUALITY ASSURANCE PROJECT PLAN ADDENDUM (SSQA)

I. SITE NAME AND LOCATION:

SITE NAME: W&B of Franklin County (formerly Missouri Green Materials, LLC) – Spent Blast Media Treatment and Removal Work Plan

ADDRESS OR OTHER LOCATION IDENTIFIER: 7627 Zero Road

CITY: Berger	**COUNTY:** Franklin	**STATE:** Missouri	**ZIP:** 63014

II. PROJECT MANAGEMENT INFORMATION:

CONTRACTOR: GREDELL Engineering Resources, Inc. on behalf of US Technology Corporation	**CONTRACTOR E-MAIL:** rickr@ger-inc.biz, travisd@ger-inc.biz
ADDRESS: 1505 East High Street, Jefferson City, Missouri 65101	
PHONE: (573) 659-9078	**FAX:** (573) 659-9079

DISTRIBUTION LIST (Check as appropriate):
☒ **U.S. EPA Region 7, AWMD/WEMM Project Manager:** Elizabeth Koesterer, Environmental Engineer
☒ **MDNR Hazardous Waste Program, Compliance and Enforcement Project Manager:** Anthony Pierce, Environmental Specialist
☒ **Consultant/Contractor Director:** Raymond Williams, US Technology Corporation, Canton, Ohio
☒ **Consultant/Contractor Project Manager:** Rick Roberts, P.E., GREDELL Engineering Resources, Inc.
☒ **Consultant/Contractor Project Field Superintendent:** Travis Doll, R.G., R.E.H.S., GREDELL Engineering Resources, Inc.
☒ **Consultant/Contractor Laboratory Personnel:** Mark Schrader, PDC Laboratories, Inc.
☒ **Technicians (Specify all):** Katherine Brookshire, E.I., and Andrew Rackers, P.E. of GREDELL Engineering Resources, Inc.
☐ **Other (Specify):**

PROJECT TYPE (Check as appropriate):
☐ **Site Investigation/Characterization** ☐ **Remedial Action** ☐ **Risk Management** ☒ **Other (specify):** Treatment and Disposal of Spent Blast Media – Considered Accumulated Hazardous Waste

PROJECT DESCRIPTION: **(Note: This SSQA supplements the Generic QAPP for Brownfields/Voluntary Cleanup Program Sites, and includes documentation only for the specific site as indicated above.)**

US Technology Corporation (US Technology) has retained GREDELL Engineering Resources, Inc. (Gredell Engineering) to develop a work plan and other required documents for the stabilization, analytical testing and disposal of spent blast media (SBM). This work plan addresses activities to be performed at the W&B of Franklin County (formerly Missouri Green Materials, LLC (MGM)) site property located at 7627 Zero Road, Berger, in Franklin County, Missouri.

The purpose of the work plan is to attain compliance by preparing the environmental plans and conducting professional environmental services required by the Environmental Protection Agency's (EPA) Region 7 Consent Agreement and Final Order (CA/FO) dated September 21, 2016, Docket No.: RCRA-07-2016-0032. These professional services include ongoing and routine sampling; analysis and documentation during the SBM processing; and final reporting of the stabilization and disposal of SBM currently stored at the W&B of Franklin County (W&B) facility. Gredell Engineering will complete these services in general accordance with the CA/FO and the August 8, 2016 Offer to Compromise Pursuant to R. 408 and Stabilization Plan prepared by Mills, Mills, Fiely & Lucas on behalf of US Technology. The proposed work will be completed by US Technology, as the contractor, and their subcontractors, while Gredell Engineering will fulfill the duties of the project manager and the engineering firm of record, in general accordance with the CA/FO.

As a part of the resolution of the disposition of SBM stored at the W&B facility, approximately 6,500 tons of recovered SBM impacted with cadmium, chromium and lead is currently stored in super sacks and drums and are proposed to be treated and stabilized on site with Portland cement and disposed at an MDNR approved Subtitle D landfill facility.

The work plan addresses the process, equipment and procedures, quality assurance, health and safety, sampling and testing methods for treating and stabilizing the SBM by adding the appropriate amount of Portland cement and water for hydration to meet the 40 CFR Part 268 Land Disposal Restrictions (LDR) prior to disposal. The treated SBM will be stored in stockpiles while the Portland cement is allowed to hydrate and stabilize the SBM contaminants of concern. Representative composite samples will be collected from each stockpile and submitted for analysis to PDC Laboratories, Inc. (PDC) in St. Louis, Missouri to confirm the success of on-site treatment. Once test results are received that a stockpile meets the LDR and landfill's disposal criteria, that stockpile will be loaded on to dump trucks and transported to the approved facility for disposal.

DATA QUALITY OBJECTIVES AND CRITERIA:

Detection Limits:	☐ **According to Generic Site Assessment QAPP**	☒ **Identified in attached PDC QA Plan**
Accuracy:	☐ **According to Generic Site Assessment QAPP**	☒ **Identified in attached PDC QA Plan**
Representativeness:	☐ **According to Generic Site Assessment QAPP**	☒ **Identified in attached PDC QA Plan**
Comparability:	☐ **According to Generic Site Assessment QAPP**	☒ **Identified in attached PDC QA Plan**
Completeness:	☐ **According to Generic Site Assessment QAPP**	☒ **Identified in attached PDC QA Plan**

SPECIAL TRAINING/CERTIFICATION REQUIREMENTS:

☒ **OSHA 40-hour (HAZWOPER) Recommended** ☐ **Geoprobe Operator** ☐ **Drill Rig Operator**
☐ **Mobile GC Field Analyst** ☒ **In-Field XRF Operator** ☐ **Other (specify):**

DOCUMENTATION AND RECORDS (Check appropriate boxes):

☒ **Field Analytical Sheets**	☐ **Log Book**	☒ **Photos**
☒ **Site Maps/Figures**	☒ **Chain-of-Custody**	☐ **Property Ownership Records**
☐ **Environmental Records Report**	☐ **Utility Clearance Forms**	☒ **Health and Safety Plan**

Other Documentation (Specify): Spent Blast Media Treatment and Disposal Work Plan

SAMPLING PROCESS DESIGN:

A. General Sampling Approach (Check appropriate boxes):

☒ **Judgmental Sampling** ☐ **Transect Sampling** ☐ **Search Sampling** ☒ **Systematic Grid**
☒ **Random Sampling** ☐ **Stratified Random Sampling** ☒ **Systematic Random Sampling**

B. Screening/Definitive Sampling (Check appropriate boxes):

☐ **Screening without Definitive Confirmation**
☒ **Screening With Definitive Confirmation**
NOTE: Minimum Confirmation Rate of 10 % for All Field Analytical Screening Samples Collected
☒ **Definitive Sampling**

SAMPLING METHODS (Specify all to be utilized):

Matrix: Soil, Treated Spent Blast Media, and Dust **Methods:** EPA Method 1311 TCLP and 6010
SOPs/Guidance: Per Work Plan and EPA Guidance
Sampling Equipment Proposed: XRF Analyzer Field Screening Soil and Dust Samples; Ghost Wipe or Prepared Filters Sampling of Dust; Stainless Steel Scoop and Mixing Bowl for Treated Spent Blast Media Samples and Background Soil Samples

SAMPLE HANDLING AND CUSTODY (Check appropriate box):

☒ **In accordance with Generic QAPP and SOPs** ☐ **Other (specify):**

ANALYTICAL METHODS (Check appropriate box):

☒ **Identified in Work Plan** ☐ **Identified Below (Describe):**

B/VCP SITE-SPECIFIC QAPP ADDENDUM FORM

QUALITY CONTROL (Check appropriate box):

☐ **Not Applicable** ☐ **In accordance with Generic QAPP** ☒ **Specific requirements (state):** Per work plan.

Describe Field QC Samples to be collected: One duplicate sample will be collected for every one in ten Spent Blast Media, Soil and Ghost Wipe samples.

INSTRUMENT/EQUIPMENT TESTING, INSPECTION, CALIBRATION/FREQUENCY AND MAINTENANCE (Check appropriate box):

☐ **Not Applicable** ☒ **In accordance with Generic QAPP** ☒ **Specific requirements (state):** Per the attached XRF Standard Operating Procedures.

Describe instrument/equipment, etc. proposed for use in this project subject to the above requirements: An XRF certified, trained and/or experienced technician may be subcontracted to perform field screening of soil and dust samples via an XRF analyzer.

INSPECTION/ACCEPTANCE OF SUPPLIES AND CONSUMABLES (Check appropriate box):

☐ **Not Applicable** ☒ **In accordance with Generic QAPP** ☐ **Specific requirements (state):**

NON-DIRECT MEASUREMENTS (Check appropriate box):

☐ **Not Applicable** ☒ **In accordance with Generic QAPP** ☐ **Specific requirements (state):**

DATA MANAGEMENT (Check appropriate box):

☒ **In accordance with Generic QAPP** ☐ **Specific requirements (state):**

ASSESSMENT AND RESPONSE ACTIONS (Check appropriate box):

☐ **In accordance with Generic QAPP** ☒ **Specific requirements (state):** Assessment and response actions will be managed by the contractor project manager and project field superintendent. PDC Laboratories, Inc. will manage laboratory quality assurance in accordance with their attached Quality Assurance Plan.

REPORTS TO MANAGEMENT (Check appropriate box):

☐ **In accordance with Generic QAPP** ☒ **Specific requirements (state):** Data from PDC Laboratories, Inc. will be submitted directly to the US Technology Corporation program director and the GREDELL Engineering Resources, Inc. field project superintendent. Data will be provided to the EPA Region 7 and/or MDNR Hazardous Waste Program, upon request, and with the final report submittal.

DATA VALIDATION AND USABILITY (Check appropriate box):

☐ **Data review and verification will be performed by the contractor or delegate in accordance with Generic QAPP, with data validation conducted according to USEPA guidance and Generic QAPP**

☒ **Data review, validation and verification will be performed as follows, with data validation conducted according to alternate methods (describe):** Data review, validation and verification will be performed in accordance with the work plan and PDC Laboratories, Inc. Quality Assurance Plan.

Field analysis utilized? Yes __X__ No ____ (If yes, memorandum, field analytical sheets, etc. from field analyst should be reviewed by the contractor after completion of field analysis).

RECONCILIATION WITH USER REQUIREMENTS (Check appropriate box):

☐ **In accordance with Generic QAPP** ☒ **Specific requirements (state):** Per work plan.

B/VCP SITE-SPECIFIC QAPP ADDENDUM FORM

APPROVALS:

U.S. EPA Region 7, AWMD/WEMM Project Manager

Name: Elizabeth Koesterer, Environmental Engineer

Signature: ____

Date:____

MDNR Hazardous Waste Program, Compliance and Enforcement Project Manager

Name: Anthony Pierce, Environmental Specialist

Signature: ____

Date:____

Contractor Director – US Technology Corporation

Name: Raymond Williams, President

Signature: ____

Date:____

Contractor Project Manager – GREDELL Engineering Resources, Inc.

Name: Rick Roberts, P.E, Senior Civil Engineer

Signature: ____

Date:____

Contractor Field Superintendent – GREDELL Engineering Resources, Inc.

Name: Travis Doll, R.G., R.E.H.S., Environmental Geologist

Signature: ____

Date:____

QUALITY ASSURANCE PROJECT PLAN FOR BROWNFIELDS/VOLUNTARY CLEANUP PROGRAM SITES

Prepared by the
Missouri Department of Natural Resources
Division of Environmental Quality
Hazardous Waste Program
Brownfields/Voluntary Cleanup Section

Missouri Department of Natural Resources
P.O. Box 176
Jefferson City, MO 65102-0176

A. PROJECT MANAGEMENT ELEMENTS

A.1 TITLE AND APPROVAL SHEET

Brownfields/Voluntary Cleanup Program
Quality Assurance Project Plan
Missouri Department of Natural Resources
Division of Environmental Quality

Site Name:__________________________

DEPARTMENT APPROVALS

Division Quality Assurance Manager	November 13, 2014 Date
Director, Hazardous Waste Program	11-7-14 Date
BVCP Quality Assurance Project Officer, HWP	10/30/14 Date

CONTRACTOR APPROVALS

Director, Contractor	Date
Project Manager, Contractor	Date
Project Field Superintendent, Contractor	Date
QA/QC Manager, Contractor	Date

A.2 TABLE OF CONTENTS

A.3 DISTRIBUTION LIST

Missouri Department of Natural Resources (MDNR)
Keith Bertels – Quality Assurance Manager, Division of Environmental Quality (DEQ)

Hazardous Waste Program (HWP)
David Lamb– HWP Director
Scott Huckstep –Brownfields/Voluntary Cleanup Program (BVCP) Section Chief and BVCP Unit Chief
Brian McCurren – BVCP Quality Assurance Project Officer
Project Managers – BVCP

Contractor/Consultant (contractor)
Director - Contractor
Project Manager–Contractor
Project Field Superintendent –Contractor
Contractor/Consultant/Laboratory – Quality Assurance Project Plan Coordinator

A.4 PROJECT/TASK ORGANIZATION

The following list identifies key individuals and organizations participating in this project, and discusses their specific roles and responsibilities as they pertain to this Quality Assurance Project Plan (QAPP).

BVCP Quality Assurance Project Officer
Responsibilities: Overall management and coordination of site-specific activities as they relate to this QAPP, including correspondence, communication and scheduling. Review plans, reports, and data to ensure that site-specific activities conducted pursuant to this QAPP meet project specific Data Quality Objectives (DQO).

Project Manager - BVCP
Responsibilities: Management and coordination of site-specific activities as they relate to this QAPP, including correspondence, communication and scheduling. Review plans, reports, and data to ensure that site-specific activities conducted pursuant to this QAPP meet project-specific DQOs.

Keith Bertels – Quality Assurance Manager, DEQ
Responsibilities: Monitors the overall Quality Assurance (QA) operations for the division. Develops and maintains the Quality Management Plan (QMP). Reviews and approves all internal QAPPs for the division.

Project Manager –Contractor
Responsibilities: Supervise and schedule field staff conducting sample collection and site assessment activities. Assures that staff are qualified and trained to perform the work, familiar with the required Standard Operating Procedures (SOP), including those related to Quality Assurance/Quality Control (QA/QC), and have the equipment necessary to perform the work. Reviews reports generated by staff for completeness, clarity and accuracy. Prepare formal reports for BVCP staff review and approval.

Project Field Superintendent - Contractor
Responsibilities: Prepare and/or implement site-specific sampling plans to collect environmental samples according to contractor SOPs at potential and/or confirmed hazardous substance sites. Conduct sample collection by appropriate methods to provide data of sufficient quality and quantity to meet project's DQOs. Prepare and/or implement health and safety plans for investigations conducted by the contractor at potential and/or confirmed hazardous substance sites. May prepare formal reports of sampling investigations for BVCP staff to evaluate.

QA/QC Manager - Contractor
Responsibilities: Reviews site-specific QAPPs and other documents as needed to ensure quality data. Performs field audits of contractor staff who conduct sampling activities in order to verify that staff are following the contractor SOPs for environmental data collection. Prepares audit reports summarizing procedures used and makes recommendations for improvement, if necessary.

Contractor/Consultant/Laboratory – QAPP Coordinator
Responsibilities: Ensures that appropriate analytical methods, Laboratory SOPs, QA/QC procedures, documentation, and training are implemented and routinely followed by all supervisory and technical staff of the contractor. Utilizes data review checklists and QC charts for both precision and accuracy data in the data quality review process. Conducts reviews of data files following review and approval by Laboratory supervisory staff.

Director - Contractor
Responsibilities: Ensures overall validation and final approval of data generated by the contractor. Assists as appropriate in the performance auditing of all activities performed by contractor personnel.

A.5 PROBLEM DEFINITION/BACKGROUND

The Brownfields/Voluntary Cleanup Program, administered by the Missouri Department of Natural Resources, Hazardous Waste Program's BVCP, provides voluntary parties with technical assistance and oversight for the investigation and cleanup of properties contaminated with hazardous substances. The goal of the BVCP is to clean up contaminated properties and bring them back into productive use.

Environmental assessments of commercial and industrial property are part of many real estate transactions and often are required by lenders and buyers as a result of the liability provisions of the federal Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), or Superfund law. If contamination is found, property owners or other interested parties often want not only to clean up the property, but also to obtain a certificate of completion or "clean letter" from the state, which provides a measure of environmental liability protection. Hazardous substance contamination is not always regulated under state and federal laws such as Superfund, the Resource Conservation and Recovery Act (RCRA), or state petroleum storage tank regulations. The contamination may be of a type or concentration that does not warrant enforcement action and may not require cleanup under existing regulations. The BVCP may be the only program with the authority to provide oversight of the cleanup and a certification of completion.

The BVCP can provide guidance so that the cleanup satisfies any applicable state and federal regulations and also provides written assurance when the project is complete. Missouri's Hazardous Substance Environmental Remediation (Voluntary Cleanup Program) Regulations (10 CSR 25-15.010) in accordance with sections 260.565 – 260.575, RSMo, provide the HWP's BVCP with the resources and the authority to provide project oversight and completion letters. Oversight costs are paid to the Department by the participant. By a memorandum of agreement with the U.S. Environmental Protection Agency (EPA), Region 7, the EPA will not pursue federal action with regard to the contamination addressed at the site once the BVCP issues a certificate of completion.

The Missouri Department of Natural Resources operates under its QMP when collecting or overseeing the collection of environmental sampling data. This plan requires that any subgrantees, contractors, or, in some cases, the regulated community, who generate environmental data develop QAPPs or other appropriate quality management tools. The QMP covers all intramural and extramural monitoring and measurement activities that generate and process environmental data for use by the department, including activities at sites participating in the BVCP.

This QAPP is generic in that it applies to several site-specific projects under the oversight of the BVCP. It is ongoing in that the projects are conducted continuously. A site-specific work plan detailing site activities will be submitted to the BVCP Project Manager for approval prior to any work conducted under the oversight of the BVCP. Any deviations from or supplemental activity to the generic QAPP will be documented in a Site-Specific Quality Assurance Project Plan Addendum (SSQA).

A.6 PROJECT/TASK DESCRIPTION

When a site enters the program, the BVCP reviews existing site assessment reports and determines whether or not additional investigation or cleanup is required to meet state standards. The site investigation and any necessary cleanup are conducted by the applicant or their consultants and contractors. Site assessment reports, remedial action plans and a final report are submitted to the BVCP for review and approval. When the BVCP is satisfied that the cleanup has met the objectives, the department provides the applicant with a Certification of Completion or "No Further Action Letter" signed by the Section Chief of BVCP. Applicants pay for the BVCP's oversight costs, which are calculated on an hourly basis. Participation in the program is voluntary and applicants may withdraw at any time.

Activities that may be conducted under this QAPP and with the oversight of the BVCP include site characterization, remedial action, and risk management. These activities will be documented through work plans for site characterization, characterization reports, risk assessment reports, remedial action plans (RAP), risk management plans (RMP), and final reports, all submitted to the BVCP for review and approval. The following include the necessary components for work plans to conduct environmental data collection submitted for BVCP approval and the necessary QA/QC documentation to be submitted after data collection.

A.6.1 Work Plans For Site Characterization

The contractor will submit the written site-specific work plan to BVCP for review and approval prior to implementation. These work plans should include a sampling and analysis plan, a field sampling plan, a health and safety plan, signature page and reference to this generic QAPP and a SSQA if applicable. The work plan will provide general site information, describe the number, type, method, and location of samples to be collected (included on a site sketch) as well as analytical parameters and methods requested for each sample.

A.6.2 Characterization Reports

The contractor will submit the written site-specific characterization report, including risk assessment reports, to the BVCP upon completion of site characterization activities. These reports should include field QA/QC documentation requirements and laboratory QA/QC documentation requirements as described in Section A.9, Documents and Records.

A.6.3 Remedial Action Plans/Risk Management Plans

If the RAP or RMP involves environmental data collection such as further site characterization, confirmatory samples following remedial activities, or monitoring, then the RAP/RMP shall be subject to this QAPP. The contractor will submit the written site-specific RAP/RMP to BVCP for review and approval prior to implementation. These plans should include a sampling and analysis plan, a field sampling plan, documentation of the health and safety plan, signature page and reference to this generic QAPP and a SSQA if applicable. The plan will provide general site information, describe the number, type, method, and location of samples to be collected (included on a site sketch) as well as analytical parameters requested for each sample.

If the RAP/RMP does not involve environmental sampling, then data QA/QC would not be a component.

A.6.4 Remedial Action/Risk Management Reports

If the RAP/RMP involves environmental sampling, then the contractor will submit to the BVCP a written site-specific report that includes field QA/QC documentation requirements and laboratory QA/QC documentation requirements as described in Section A.9, Documents and Records.

A.6.5 Modifications to the Work Plans

BVCP will have the final approval of all individual components of the written work plans revised as specified herein and reserves the right to require modifications, deletions, and or additional elaboration to the written work plans and reports as BVCP deems necessary.

A.6.5.1 BVCP requested changes

If BVCP determines that modifications to the written work plan are necessary or desired, the agency will document the requested changes to the contractor in writing. Such changes may include the need for additional sampling at the site.

Based on the written instructions provided by BVCP, the contractor will revise the written work plan.

A.6.5.2 Contractor requested changes

If the contractor determines that modifications to the written work plan are necessary, the contractor will submit a written request to BVCP for changes. The written request will include the reason for the modification and will detail the contractor's proposed changes to the written work plan. BVCP will review the written request of the contractor and send written notice of approval or disapproval of the request to the contractor.

A.6.5.3 Field Deviations from the Work Plan

Changes in site conditions between the time of the site reconnaissance and the on-site sampling visit and the visual appearance of the substance at the time of sampling may determine the actual number and locations of samples collected. The contractor should contact the BVCP Project Manager to discuss deviations or changes. The deviations or changes will be documented in the final report prepared by the contractor and submitted to the BVCP.

A.7 DATA QUALITY OBJECTIVES AND CRITERIA

DQOs are qualitative and quantitative statements derived from the Systematic Planning and DQO processes developed by EPA and further described in *Guidance on Systematic Planning Using the Data Quality Objectives Process* and *Systematic Planning: A Case Study for Hazardous Waste Site Investigations.* Data quality indicators as discussed in Section B.5 will be used to ensure quality data for sampling conducted pursuant to this QAPP.

A.7.1 Problem Statement

Properties are enrolled in BVCP for the investigation, remediation, and risk management of hazardous substances. To accomplish that, data is collected during investigation, remediation, and verification sampling activities.

The data collected will contribute to the conceptual site model (CSM), which is a functional description of the contamination problem. The CSM should be maintained and updated throughout the life of the project as information is collected. Key elements of the conceptual site model include:

- The chemical release scenario, source(s), and chemicals of concern (COCs)
- Spatial and temporal distribution of COCs in the various affected media
- Current and future land and groundwater use
- Description of any known existing or proposed land or water use restrictions
- Description of site stratigraphy, determination of the predominant vadose zone soil type, hydrogeology, meteorology, and surface water bodies that may potentially be affected by site COCs
- Remedial activities conducted to date
- An exposure model that identifies the receptors and exposure pathways under current and future land use conditions

A.7.2 Decision Statements

A.7.2.1
Do maximum concentrations of COCS exceed the Missouri-Risk Based Corrective Action (MRBCA) Default Target Levels (DTLs) or appropriate Water Quality Criteria (WQC)?

A.7.2.2
Does risk at the site exceed the allowable risk levels of a MRBCA tiered risk assessment?

A.7.2.3
Has remediation been sufficient to reduce risk to allowable levels and issue a certificate of completion?

A.7.2.4
Is risk management and long-term stewardship (LTS) necessary to issue a certificate of completion?

A.7.3 Inputs into the Decision
The inputs into the decision are any data collected as part of the activities listed in Section A.6. This data will be compared to action levels listed in the MRBCA guidance document and will be used as part of a risk assessment in accordance with the MRBCA guidance.

A.7.4 Study Boundaries
The study boundary is the legal property boundary of the site that has been enrolled in BVCP, unless hazardous substances originating on the enrolled property have migrated to adjacent properties, in which the case the study boundary is extended to include the maximum extent of that hazardous substance migration.

A.7.5 Decision Rules

A.7.5.1 Initial Characterization
- Do maximum concentrations of COCS exceed the MRBCA DTLs or appropriate WQC? If no, a certificate of completion may be issued. If yes, a Tier 1 risk assessment must be conducted.

A.7.5.2 Tier 1 Risk Assessment
- Do Tier 1 risks exceed acceptable risk levels? If no, a certificate of completion may be issued. If yes, remediate to acceptable risk levels or manage risks.
- Will risks be managed at the Tier 1 level? If no, a Tier 2 risk assessment must be conducted. If yes, develop and implement a RMP.
- If an RMP is completed and LTS is in place, a certificate of completion may be issued.

A.7.5.3 Tier 2 Risk Assessment

- Do Tièr 2 risks exceed acceptable risk levels? If no, a certificate of completion may be issued. If yes, remediate to acceptable risk levels or manage risks.
- Will risks be managed at the Tier 2 level? If no, a Tier 3 risk assessment must be conducted. If yes, develop and implement an RMP.
- If an RMP is completed and LTS is in place, a certificate of completion may be issued.

A.7.5.3 Tier 3 Risk Assessment

- Do Tier 3 risks exceed acceptable risk levels? If no, a certificate of completion may be issued. If yes, remediate to acceptable risk levels or develop and implement an RMP.
- If an RMP is completed and LTS is in place, a certificate of completion may be issued.

A.7.6 Limits on Decision Error

For most projects conducted under this QAPP, the null hypothesis will be that a site is contaminated at levels that require additional investigation and remedial actions. There are two general types of decision errors:

- Type 1 Decision Error (sometimes called a false rejection error): Concluding that a site does not pose a potential threat to human health and the environment), when the site truly does pose a threat.

- Type 2 Decision Error (sometimes called a false acceptance error): Concluding that a site poses a potential threat to human health and the environment, when the site truly does not pose a threat.

The consequences of a Type 1 Decision Error, mischaracterizing a site that truly poses a threat, could have future health implications. This decision error could result in populations being exposed to unsafe levels of contaminants.

The consequences of Type 2 Decision Error, incorrectly identifying a site for further investigation and remediation, would cause the needless expenditure of resources (e.g. funding, time, sampling crew labor, and analytical costs).

When a sufficient number of samples are planned, it may be possible to assign numerical limits on tolerable decision error rates and use a statistical data analysis approach. In such cases, an error tolerance of 95% will be used unless project-specific DQOs specify otherwise. However, numerical values are typically not set when a judgmental sampling approach is used or when limited numbers of sample prevent statistical analysis. In these instances, decision errors are limited in a variety of more general ways.

The probability of making a false rejection decision error, thereby mischaracterizing a site that truly poses an unacceptable risk to human health and the environment, is limited by several factors. Recognized Environmental Conditions (RECs) will be identified in the Phase I Environmental Site Assessment (ESA), and decision error will be limited by using judgmental sampling to target the worst-case contaminant locations by sampling RECs where the largest contaminant release would have occurred. When contaminants are detected, decision error will also be limited by comparing contaminant concentrations to the conservatively-derived target levels in the MRBCA guidance.

A.7.7 Design Optimization

For each project, contractors and BVCP will review the DQO output from Sections A.7.1 through A.7.6 together with existing environmental data for the site, and develop a sample collection design based on this review. The sample collection design will specify the type, location, frequency, analyses per sample, analytical methods, and QC samples. Rationale for the location of samples and types of analyses will be thoroughly developed and supported.

A.8 SPECIAL TRAINING/CERTIFICATION

Sample collectors are required to successfully complete a 40-hour Hazardous Waste Operations and Emergency Response (HAZWOPER) site safety course in accordance with 40 CFR Part 311, which references 29 CFR 1910.120. Staff are also expected to be trained on sampling for hazardous materials as well as read and be familiar with applicable SOPs, the generic QAPP, the site-specific work plan(s) and the SSQA prior to performing actual sample collection. Some sample collectors may need to be licensed inspectors for asbestos-containing material (ACM) and lead-based paint (LBP).

Specific training requirements may be necessary for personnel operating field analytical or sampling equipment or specialized equipment, such as an X-ray Fluorescence (XRF) analyzer or geophysical instruments. Manufacturer's requirements and recommendations should be followed.

The contractor will ensure and provide for the protection of the personal safety and health of all its workers on site, including the selection, provision, testing, decontamination, and disposal of all Personal Protective Equipment (PPE) and any required medical monitoring. The contractor will comply with all applicable worker safety and health laws and regulations. At all times during performance of services, the contractor will exercise reasonable professional judgment regarding safety and will use professional judgment as a criterion for cessation of services for safety reasons.

A.9 DOCUMENTS AND RECORDS

Work plans and final reports will be generated and submitted to BVCP for review and approval.

Field QA/QC documentation for site characterization reports and/or remedial action/risk management reports must consider the following details:

- Calibration and maintenance records for field instrumentation,
- Documentation of sample collection procedures,
- Reporting of any variances made in the field to sampling plans, SOPs or other applicable

guidance documents,
- Reporting of all field analysis results,
- Documentation of sample custody (provide copies of chain-of-custody documents),
- Documentation of sample preservation, handling and transportation procedures,
- Documentation of field decontamination procedures (and if applicable, collection and analysis of equipment rinsate blanks),
- Collection and analysis of all required duplicate, replicate, background and trip blank samples, and
- Documentation of disposal of investigation-derived wastes.

Laboratory QA/QC documentation for site characterization reports and/or remedial action/risk management reports must consider the following details:
- If the published analytical method used specifies QA/QC requirements within the method, those requirements must be met and the QA/QC data reported with the sample results;
- At a minimum, QA/QC samples must consist of the following items (where applicable): method/instrument blank, extraction/digestion blank, initial calibration information, initial calibration verification, continuing calibration verification, laboratory fortified blanks/laboratory control samples, duplicate, and matrix spikes/matrix spike duplicates. The site characterization and/or remedial action/risk management reports must include a discussion of data quality.
- Documentation of appropriate instrument performance data such as internal standard and surrogate recovery.

B: DATA GENERATION AND ACQUISITION

B.1 SAMPLING PROCESS DESIGN

This QAPP is generic, covering many different projects and a large number of analytes in various complex sample matrices. The sampling design will vary depending on the goal of the sampling activity, such as site characterization or confirmatory sampling. Therefore, the sampling process design will be described in detail in the site-specific work plan and/or SSQA. Some considerations when developing a plan for a sampling design, particularly a judgmental sampling design, include potential contaminant(s) and locations based on past property uses, soil properties that affect contaminant migration, physical and chemical nature of potential contaminant(s), the manner in which contaminant(s) may have been released, and timing, duration and amount of potential release(s). Since this QAPP is generic in the sense that it is intended to apply broadly to a number different specific sites, it is not possible to provide specific sampling design details. However, the following sampling design elements will be considered and discussed in the site-specific sampling plans or SSQA as describe in A.6 written for each investigation.

- Description of the design strategy, including size/volume of area to be sampled
- Type and total number of samples to be collected
- Locations of samples to be collected and rationale for selection.
- Identify anticipated sources of variability in the data and how it will be controlled.

All QC samples will be collected in accordance with EPA guidance and described in the site-specific work plan and/or SSQA. All QC samples will be documented in the sampling report. See Section B.5 for more information on QC samples.

B.2 SAMPLING METHODS

The field investigations and sample collection activities under the project will adhere to applicable SOPs and available EPA guidance and will be described in the site-specific work plan and/or SSQA. The site-specific work plan will indicate the location, type, number and media of the samples.

Manufacturer's specifications and operational instructions, other agency SOPs, other methods, instructions, including professional or scientific technical standards, may also be used for specific field analytical equipment, geophysical equipment, surveying instruments, etc. with no existing SOPs or EPA guidance upon approval of the BVCP Project Manager. The site-specific work plan will specify sampling methodologies and procedures used.

B.3 SAMPLE HANDLING AND CUSTODY

Sample handling and custody will be accomplished according to SOPs and using standard forms developed by contractor's laboratories. Sample container selection will be according to appropriate method guidance and/or SOPs. The site-specific work plan will specify sample handling procedures, sample containers, preservation, holding times, chain-of-custody and field documentation, handling of samples in the field, and transport of samples to the laboratory. All analyses will be conducted within the method-specified maximum sample holding time limits. Any data obtained from analyses conducted on samples after the specified holding time limit will be qualified by the laboratory in sample result documentation and discussed in the sampling report.

B.4 ANALYTICAL METHODS

Field analytical measurements will be according to SOPs and manufacturer's operational instructions, such as immunoassay kit instructions, photoionization detector (PID) instructions, XRF manual, etc. Calibration and other QA/QC actions will be accomplished according to SOPs, manufacturer's minimum recommendations/requirements and other appropriate scientific or technical standards. Appropriate EPA guidance, SOPs, best professional judgment and accepted industry and scientific practices will be used when correlating field analytical data to laboratory data.

Laboratory measurements will be performed by the selected laboratory according to the method requested, generally according to container, preparation, and analytical methods specified by EPA SW-846 Solid Waste Test Methods. The QC procedures specified in these methods must be followed. The detection limits of the selected analytical methods generally will be able to achieve the concentrations of interest needed. Analytical parameters will vary by project; therefore, the analytical methods used for the parameters of concern should be specified in the site-specific work plan and/or SSQA. Analytical results obtained for projects conducted under this QAPP will be compared to the Department's MRBCA Guidance. Ideally, the laboratory reporting limits would be at or below the MRBCA target levels in each environmental media. However, these risk-based levels do not take into account analytical feasibility. Even using the best available measurement technology, laboratory-reporting limits will exceed benchmarks for some analytes in some environmental media. There may be special circumstances where a higher level of sensitivity for some analytes will be required. Data that do not meet the laboratory reporting limits will be qualified as described in the applicable verification/validation procedure, and documented in the project report.

Any non-standard analytical methods, along with associated validation procedures, should be specified in the site-specific work plan and/or SSQA, and will need prior approval by the BVCP. An explanation as to why non-standard methods are being proposed should also be included in the site-specific work plan and/or SSQA.

All QC documentation must be provided with each analytical deliverable package. The contractor will be responsible for ensuring all analytical data provided by the contractor's laboratory for the project meets the contract requirements and the requirements of this QAPP.

B.5 QUALITY CONTROL

A number of field and laboratory QC checks will be required to ensure data meet the project DQOs. The principal quality attributes important to site assessment projects are precision, accuracy, comparability, representativeness, and completeness. Criteria for these attributes are discussed below.

B.5.1 Principal Quality Attributes

1. Data Precision

Data Precision is a measure of the reproducibility of analytical results and is typically expressed in terms of the standard deviation among a set of data or as the relative percent difference between two measurements. Overall precision will be measured using the Relative Percent Difference (RPD) between duplicate or replicate split samples.

$$RPD = 100\left[\frac{x_1 - x_2}{\bar{x}}\right]$$

- The criterion for RPD between primary and duplicate aqueous samples for each contaminant measured above the laboratory reporting level is $\leq 30\%$.
- The criterion for RPD between primary and replicate split non-aqueous samples and for duplicate non-aqueous volatile organic compounds (VOC) samples will be $\leq 50\%$.
- The criterion for RPD between primary and duplicate air samples will be 25%.

If data fall within these limits, then the overall precision of the sampling and analytical process is adequate to meet the project DQOs. Data that do not meet these precision criteria will be qualified as described in the applicable validation procedure (Section D), and discussed in the project report.

2. Laboratory Precision

Precision of laboratory analyses is assessed by the analysis of Matrix Spike/Spike Duplicates (MS/MSD), laboratory duplicate samples, and blind performance evaluation samples. The frequency with which laboratory precision is assessed, and the performance criteria vary by analyte, analytical method, and environmental media. The criteria and methods for assessment of laboratory precision are specified in the analytical methods.

3. Accuracy

Accuracy is a measure of the bias that exists in a measurement system. The accuracy of laboratory analyses will be assessed by analysis of preparation/method blanks, laboratory control samples, surrogates, internal standards, matrix spikes, and blind performance samples. The frequency with which laboratory accuracy is assessed, and the performance criteria vary by analyte, analytical method, and environmental media. Criteria for laboratory accuracy are specified in the analytical methods.

Field accuracy will be assessed through the analysis of trip blanks and field equipment rinse blanks. Contaminants should not be detected above the laboratory reporting level in trip blanks and equipment rinse blanks. Any data that do not meet these accuracy criteria will be qualified as described in the applicable validation procedure. The BVCP Project Manager and applicant's contractor will evaluate all qualified data on a project-specific basis, and determine how/whether to use the data.

4. Data Comparability

Comparability is the degree of confidence with which one data set can be compared to another. The objective of comparability for this QAPP is to ensure that sampling data developed during the project investigation may be readily compared to each other and to the appropriate screening benchmarks. All data will be reported as degrees Celsius (flash point); pH units; µg/l or mg/l for water, liquids or Toxicity Characteristic Leachate Procedure (TCLP); µg/kg or mg/kg for soil, sediment or other solids; and µg/m3 for air. Comparability is further addressed by using appropriate field and laboratory methods that are consistent with current standards of practice as approved by EPA.

5. Data Representativeness

Representativeness is the degree to which sampling data accurately and precisely depicts selected characteristics such as parameter variations at a sampling point or an environmental condition and is ensured for projects under this QAPP in several specific ways:

- Use of correct sampling procedures and equipment
- Adherence to QA and QC requirements for ensuring sampling integrity
- Collection of an adequate amount of sampled material
- Selection and implementation of appropriate analytical measurement method, including sample preparation

6. Data Completeness

Completeness is the measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under "normal" conditions and is expressed as a percentage of the amount of valid data obtained compared to the amount that was planned. One hundred percent of data completeness is desired for the collection of field samples for all project investigations. If less than 100 percent is received, the BVCP Project Manager will decide if the valid data obtained from a measurement system compared to the amount that was expected to be obtained under normal conditions is sufficient to meet the project DQOs. If not, additional sampling may be required.

B.5.2 QC Samples

QC samples will be required to verify the validity of analytical results and to assess whether the samples were contaminated from sources not directly attributable to releases at the site (such as improper decontamination, cross-contamination, laboratory contamination, etc.). The field QC samples proposed for collection will be included in the site-specific work plan. Field QC samples include the following as appropriate:

- Trip blanks indicate if any activities after obtaining the trip blank may have contaminated samples during transport.
- Field blanks are samples obtained in the field to determine if contaminants were introduced by sample containers, preservatives, sampling procedures, etc.
- Rinsate samples are obtained to verify adequate decontamination of sampling equipment.
- Replicate samples (split samples) are obtained by dividing or splitting one sample that has been mixed or homogenized into two samples for separate analysis. Replicate samples primarily assess precision associated with analytical procedures, and to a lesser extent, sample handling procedures. Replicate split samples of soils or other non-aqueous materials are not recommended if volatile organics analyses are requested due to the potential loss of the volatiles during the mixing process. If soil samples will be analyzed for VOCs, duplicate samples should be collected prior to mixing. However, please note that there may be a greater potential for inconsistency due to the heterogeneous nature of soils or other non-aqueous media
- Duplicate water samples are used primarily to assess precision associated with sampling methodology, and to a lesser extent sample heterogeneity and analytical procedures. Duplicate soil samples are used primarily to determine the variability or heterogeneity of the sampled media.

For all projects involving the collection of aqueous samples, a trip blank will be included at a frequency of one per cooler if the proposed analysis includes VOCs or semi-volatile organic compounds (SVOCs). An equipment rinsate blank will be collected for projects where the sampling equipment is decontaminated in the field for reuse. The equipment rinsate blank will be collected at a frequency of one per separate sampling event (mobilization) for each different combination of sampling equipment, decontamination method, and analytical parameter. Duplicate or replicate samples for each media (groundwater, surface water, soil/sediment, air) should be collected at a frequency of 10% of the total number of samples, with a medium of one duplicate or replicate per medium per sampling event.

BVCP will collect duplicate or replicate samples from the site, including, but not necessarily limited to, post-remediation verification samples at BVCP sites. The goal is to enhance the credibility of BVCP cleanups by documenting MDNR's direct oversight of verification sampling, as well as confirming the analytical results. BVCP will collect a limited number of samples (approximately 10% of the total number of samples), and pass the analytical costs back to the sites as oversight costs, as allowed by our regulations.

Contaminants should not be detected above the laboratory reporting level in trip blanks, field blanks, and equipment rinse blanks. Any data that do not meet these accuracy criteria will be qualified on sample results. The BVCP Project Manager and contractor personnel will evaluate all qualified data on a project-specific basis, and determine how/whether to use the data.

All QC samples will be documented in the sampling report.

Laboratory QC samples include duplicates, spikes, laboratory blanks, and performance evaluation samples, and are performed by the fixed laboratory according to the approved laboratory QA/QC plans.

B.6 INSTRUMENT/EQUIPMENT TESTING, INSPECTION AND MAINTENANCE

Field analytical instruments used during this project will be maintained and calibrated according to instructions provided by the instrument manufacturer, and other appropriate scientific and technical guidance and standards pertinent to the specific instrument in use. The contractor will be responsible for performing operational checks on all field equipment prior to use in the field. An operational problem with any field instrumentation will be noted by the contractor in the field notebook. Daily or regular calibration of field instrumentation will be according to applicable SOPs and manufacturer's instructions and indicated or referenced in the site-specific work plan.

Fixed laboratory equipment for contract laboratories used for quantitative sample analysis will be tested, inspected, calibrated and maintained according to the specific analytical equipment requirements as stated in the SOPs of the laboratory, in accordance with manufacturer-specified procedures or method-specified procedures, as appropriate.

B.7 INSTRUMENT/EQUIPMENT CALIBRATION AND FREQUENCY

Maintenance and calibration procedures will be conducted in accordance with manufacturers' instrument manuals, method-specified procedures and the laboratory SOPs, as appropriate.

B.8 INSPECTION/ACCEPTANCE OF SUPPLIES AND CONSUMABLES

Inspection and acceptance of supplies and consumables will be conducted according to applicable SOPs. Any supplies and consumables used in the sample collection process or instrument calibration such as sample bottles, bailers, dedicated tubing, deionized water, calibration gases, etc., will be inspected upon receipt and prior to use.

B.9 NON-DIRECT MEASUREMENTS

Several types of data and information may be obtained from non-measurement sources for use in projects conducted under this QAPP. The primary types of non-measurement data are Phase I ESAs, site reconnaissance, interviews of site owners or operators, published reference books and resources, databases, and internet resources. These data may be used to design sampling plans and may be used with the directly measured data collected during each project to evaluate the potential need for further site characterization, remediation and/or suitability for development.

Non-direct measurement data will be documented and referenced in any document for which they are used.

B.10 DATA MANAGEMENT

Data management, including chain-of-custody review and correction, data review, reduction and transfer to data management systems, quality control charts, quality control procedures, and sample receipt, storage and disposal, will be in accordance with applicable SOPs and accepted industry practices.

Documentation will be in accordance with applicable SOPs and accepted industry practices, and will include the sampling reports, copy of the chain-of-custody, and field notes or other supporting documentation with the analytical results. Data reduction will occur in accordance with contractor analytical SOPs for each parameter. If difficulties are encountered during sample collection or sample analyses, a brief description of the problem will be provided in the sampling report prepared by contractor. Data reporting will be in accordance with applicable SOPs and will include, at a minimum:

- Sample documentation (location, date and time of collection and analysis, etc.)
- Chain-of-custody forms
- Initial and continuing calibration
- Determination and documentation of detection limits
- Analyte(s) identification
- Analyte(s) quantitation
- Quality Control sample results

Adequate precautions will be taken during the reduction, manipulation, and storage of data in order to prevent the introduction of errors or the loss or misinterpretation of data.

C: ASSESSMENT AND OVERSIGHT

C.1 ASSESSMENTS AND RESPONSE ACTIONS

This section describes the internal and external checks necessary to ensure that all elements of the QAPP are implemented correctly as prescribed, that the quality of the data generated by implementation of the QAPP is adequate, and that any necessary corrective actions are implemented in a timely manner.

C.1.1 Laboratory Performance Assessment

Laboratories will comply with all of the EPA and the National Environmental Laboratory Accreditation Conference (NELAC) requirements for laboratory QA programs. Data resulting from the participation in the NELAC program shall be reviewed by the laboratory Quality Assurance Manager and any problems shall be addressed.

C.1.2 Field Performance Assessment

The auditor in charge of field QA will conduct audits of field activities according to contractor QA field auditing procedures. The process of choosing when field audits are conducted is not based on a particular project or site-sampling event, but rather on assuring that each person involved in sample collection is audited at least once per year. The contractor's field QA auditor will have the responsibility for initiating and implementing response actions associated with findings identified during the field audit. The field personnel shall properly address any response actions needed.

C.1.3 Overall Project Performance Assessment

EPA VII conducts periodic QA audits of the state's environmental programs. These evaluations normally include some type of review of the program's quality system, and may include review of QAPPs.

C.1.4 Data Validation

All field and laboratory data will be subject to validation to review for accuracy, precision, completeness, representativeness and comparability. Data validation is discussed in more detail in Section D. The acceptance criteria for measurement data are discussed in Section B.5.

C.2 REPORTS TO MANAGEMENT

Data from the contractor's laboratory will be submitted to the BVCP Project Manager as an appendix to the final report using the laboratory analytical report sheets. The report sheets will include documentation of the sampling location, sample description, date of collection, collector, analysis performed and results, date of analysis, and analytical method used. A copy of the chain-of-custody and the lab results should also be attached to the final report. In addition, a discussion of data quality should be provided with the sampling report.

Field performance assessment audits will be documented by the contractor's field QA auditor in a written report that will be kept on file at the contractor's office. Results from the laboratory's audit studies will be kept on file at the contractor's office.

Comments and recommendations from the EPA Region VII periodic QA audits of state environmental programs are provided to the Department QA manager and used by Department management and staff to take any corrective actions which may be needed.

D: DATA VALIDATION AND USABILITY

D.1 DATA REVIEW, VERIFICATION AND VALIDATION

To ensure that measurement data generated when performing environmental sampling activities are of an appropriate quality, all data will be validated. Data validation is a systematic procedure for reviewing a body of data against a set of established criteria to provide a specified level of assurance of its validity prior to its intended use. The techniques used must be applied to the body of the data in a systematic and uniform manner. The process of data validation must be objective and independent of the data production process. All data, as applicable, will be validated in accordance with EPA *Guidance on Environmental Data Verification and Data Validation, Data Quality Assessment: A Reviewers Guide*, and *Data Quality Assessment: Statistical Tool for Practitioners*. Any deviations will be documented and provided with the analytical data report.

D.2 VERIFICATION AND VALIDATION METHODS

D.2.1 Documentation, Data Reduction and Reporting

Documentation will include the sampling reports, copy of the chain-of-custody, and field notes or other supporting documentation with the analytical results. Data reduction will occur in accordance with the laboratory's analytical SOPs for each parameter. If difficulties are encountered during sample analyses, a brief description of the problem will be provided.

Data derived from sampling events undertaken for projects under the oversight of the BVCP will be reported to the BVCP Project Manager as discussed in Section C.2, Reports to Management.

D.2.2 Data Validation

Data validation will occur as described in the analytical SOPs for each parameter and the laboratory SOPs for data review. Data validation is accomplished using control charts and data review checklists. Discrepancies are noted in the analytical file and appropriate data flags are used. If data is determined to be outside of control limits, the data is flagged on the report of analysis.

The laboratory personnel and contractor will look at matrix spikes/matrix spike duplicates, lab blanks, and lab duplicates to ensure they are acceptable. The sample collector will compare the sample descriptions with the field sheets for consistency and ensure that any anomalies in the data are documented. The contractor will perform a final review and approval to ensure that the data meets the quality objectives of this QAPP as discussed in Section B.5. and, if applicable, the SSQA. The contractor's review and approval is a check on the reviews conducted by the laboratory to ensure consistency of all field and analytical data that is generated by the contractor.

D.3 RECONCILIATION WITH USER REQUIREMENTS

Once the final report is submitted, the BVCP Project Manager will review the field QA samples to determine if they appear to indicate a problem with meeting quality objectives. If problems are indicated, the BVCP Project Manager will contact the contractor to discuss and attempt to reconcile the issue. Completeness will also be evaluated to determine if the completeness goal for this project has been met. If data quality indicators do not meet the project's requirements as outlined in this QAPP and applicable SSQA, the data may be discarded and re-sampling may occur. The BVCP Project Manager will determine the cause of the failure (if possible) and make the decision to discard the data and re-sample. If the failure is tied to the analyses, calibration and maintenance techniques will be reassessed as identified by the appropriate lab personnel. If the failure is associated with the sample collection and re-sampling is needed, the sampling methods and procedures will be reassessed as identified by the field audit process.

Corrective action will be undertaken by all parties to address specific problems as they arise. Corrective actions required will be identified through the use of control charts for chemical analyses, precision and accuracy data, through performance auditing, and through systems audits.

REFERENCES

- EPA Guidance on Environmental Data Verification and Data Validation (G-8), EPA/240/R-02/004, November 2002
- EPA Guidance Data Quality Assessment: A Reviewer's Guide (G-9R), EPA/240/B-06/002, February 2006
- EPA Guidance Data Quality Assessment: Statistical Tools for Practitioners (G-9S), EPA/240/B-06/003, February 2006
- EPA Guidance on Systematic Planning Using the Data Quality Objective Process (G-4), EPA/240/B-06/001, February 2006
- EPA Guidance for Quality Assurance Project Plans (G-5), EPA/240/R-02/009, December 2002.
- EPA Requirements for Quality Assurance Project Plans (R-5), EPA/240/B-01/003, March 2001
- EPA Systematic Planning: A Case Study for Hazardous Waste Site Investigations (CS-1), EPA/240/B-06/004, February 2006
- MDNR-ESP-210-Quality Assurance/Quality Control for Environmental Data Collection

APPENDIX A: LISTING OF ACRONYMS & TERMS

ACM	Asbestos-Containing Material
BVCP	Brownfields/Voluntary Cleanup Program
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
COCs	Contaminants of Concern
CSM	Conceptual Site Model
DEQ	Division of Environmental Quality
DTL	Default Target Level
DQO	Data Quality Objectives
EPA	United States Environmental Protection Agency
ESA	Environmental Site Assessment
HAZWOPER	Hazardous Waste Operations and Emergency Response
HWP	Hazardous Waste Program
LBP	Lead-Based Paint
LTS	Long-term Stewardship
MCL	Maximum Contaminant Level
MDNR	Missouri Department of Natural Resources
MRBCA	Missouri Risk-based Corrective Action Process
MS/MSD	Matrix Spike/Spike Duplicates
NELAC	National Environmental Laboratory Accreditation Conference
PID	Photoionization Detector
PPE	Personal Protection Equipment
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
QMP	Quality Management Plan
RAP	Remedial Action Plan
RCRA	Resource Conservation and Recovery Act
REC	Recognized Environmental Conditions
RMP	Risk Management Plan
RPD	Relative Percent Difference
SOP	Standard Operating Procedure
SSQA	Site-Specific Quality Assurance Project Plan Addendum
SVOC	Semi-Volatile Organic Compound
TCLP	Toxic Characteristic Leaching Procedure
VOA	Volatile Organic Analysis
VOC	Volatile Organic Compound
WQC	Water Quality Criteria
XRF	X-ray Fluorescence

Duplicate or co-located sample is a sample obtained from the same location, at the same time, and of the same material as the original sample. Duplicate water samples are used primarily to assess precision associated with sampling methodology, and to a lesser extent sample heterogeneity and analytical procedures. Duplicate soil samples are used primarily to determine the variability or heterogeneity of the sampled media. Due to the heterogeneity of soils, caution must be used if attempting to assess precision associated with sampling methodology or analytical procedures.

Hazardous Substance means a substance defined as hazardous pursuant to federal rule 40 CFR 302.4, which includes asbestos and Polychlorinated Biphenyls (PCBs); any substance designated pursuant to Section 311(b)(2)(A) of the federal Water Pollution Control Act; any toxic pollutant listed under Section 307(a) of the federal Water Pollution Control Act; any hazardous air pollutant listed under Section 112 of the Clean Air Act; any imminently hazardous chemical substance or mixture with respect to which the Administration of EPA has taken action pursuant to Section 7 of the Toxic Substances Control Act; any hazardous waste; any hazardous material designated by the Secretary of the U.S. Department of Transportation under the Hazardous Materials Transportation Act; any radioactive materials; or any petroleum product.

Hazardous waste means waste defined to be hazardous pursuant to the Missouri Hazardous Waste Management Law Section 260.350 to Section 260.430 or pursuant to federal rule 40 CFR 261.

Replicate split sample is obtained by dividing or splitting one sample that has been mixed or homogenized into two samples for separate analysis. A replicate split is collected primarily to assess precision associated with analytical procedures and to a lesser extent sample handling procedures. Replicate split samples of soils or other non-aqueous materials are not recommended if volatile organics analyses are requested due to the potential loss of the volatiles during the mixing process. Duplicate samples for volatile organics analyses are sometimes collected prior to mixing, however, there may be a greater potential for inconsistency due to the heterogeneous nature of soils or other non-aqueous media.

APPENDIX B: ANALYTICAL REQUIREMENTS

The detection limits, as specified in 40 CFR 136 Appendix A and the EPA SW-846 Methods, are sufficient for most project under the oversight of the BVCP. The accuracy and precision of each analytical method are determined by using spikes and spike duplicate analyses, as specified in the EPA SW-846 methods.

ATTACHMENTS

ATTACHMENT 1

Example Standard Operating Procedure for Measurement of Metals with XRF

Example Standard Operating Procedure
For Measurement of Metals with the Niton XRF

This example standard operating procedure (SOP) is prepared for sampling and analyzing metals in construction materials and soils using the Niton x-ray fluorescent spectrometer (XRF). This SOP is generalized to the work required in response to the site investigation and materials removal and disposal activities. It should be noted that following the procedures in the SOP will produce quantitative sampling data. Use Daily XRF Sample Log or Log Book to record every XRF measurement. Use pen at all times. Any errors are to be marked out with one line and initialed.

Equipment and Materials needed:

• XRF Spectrometer	• Blank sample (clean sand) provided by Niton
• Spare batteries for XRF and charger	• Daily XRF Sample Log(s) or Log Book
• Cotton swabs	• Field Data Sheet(s)
• Ziploc bags	• Checklists from this SOP
• XRF cups	• Laboratory chain-of-custody
• Stainless steel bowls	• Laptop (optional) or calculator
• Reference samples provided by Niton	• Pens
• Trowel and/or trier	• Markers

A. XRF PREPARATION PROCEDURE

At the beginning of each day or each sampling activity, the following steps need to be completed to document calibration, accuracy and precision. Table 1 provides a beginning of the day checklist. **Use Daily XRF Sample Log or Log Book (attached) to record every XRF measurement.**

A1 Use cotton swab to clean the XRF analysis window of any dust accumulated since last use.

A2 Turn on XRF and allow to warm up for 15 minutes.

Table 1 – Beginning of Day Checklist

Date:_________________ Time:__________________ **Activity (see description below for detail)**	**Complete?**	**Status**
Clean XRF window		
Allow XRF to warm up for 15 minutes		
Check instrument's date and time		
Perform internal calibration check		
Analyze instrument blank		
Analyze CVC sample – NIST Low 2709 [calculate %D (< 20%) using the measurement and the marked concentration]		
Analyze CVC sample – NIST Med 2711 [calculate %D (< 20%) using the measurement and the marked concentration]		
Analyze CVC sample – NIST High 2710 [calculate %D (< 20%) using the measurement and the marked concentration]		

A3 Check the instrument date and time. If incorrect, consult manual to set correct date and time. NOTE: do not run instrument if date and time are incorrect.

A4 Perform instrument self calibration:

A4a. Go to the Setup Menu and select Mode – note the NITON XRF will start up in the mode it was turned off in. The user should make a habit of selecting the mode each morning to ensure data quality. The Niton XRF will provide the choices of *"Test Soil, Bulk Samples", "Thin Sample", or "Paint".*

A4b. Select "Test Soil, Bulk Samples" by moving arrows and pressing "Clear/Enter". **Note to the user:** the *instrument must be calibrated and tested for accuracy and precision each morning in the soil testing mode.*

A4c. Instrument will return to Main Menu.

A4d. Select Calibrate and Test by moving arrows, if necessary, and pressing "Clear/Enter".

A4e. Self-calibration will take approximately 1 to 2 minutes and instrument will beep upon completion and display "Ready to Test".

A5 Record status of instrument self calibration:

A5a. If instrument is calibrated proceed.

A5b. If instrument failed the self calibration, push the Reset button on the bottom of the instrument and recalibrate (see step A.3). If the instrument does not calibrate successfully in three attempts, call NITON service 401-294-1234.

A6 Analyze a blank. A blank is clean silica sand (99.5%). Record instrument reading on the Daily XRF Sample Log or Log Book. If instrument detects lead, reclean the XRF analysis window with a cotton swab. Reanalyze blank and record instrument reading.

A7 Analyze the three CVC samples – NIST reference samples Low 2709, Med 2711, and High 2710. Record all measurements on the Daily XRF Sample Log or LogBook. Calculate the percent difference (%D) of each measured sample using the following equation or the provided Excel Spreadsheet.

$$\%D = \frac{|(CVC_m - CVC_s)|}{CVC_s} \times 100$$

%D = percent difference
CVC_m = Measured concentration of the CVC sample
CVC_s = Marked standard concentration of the CVC sample – see Table 2 for the standard concentration

Table 2 - CVC Standard Concentrations

Standard	Lead Concentration (CVC_s)
NIST Low 2709	18.9
NIST Med 2711	1162
NIST High 2710	5532

If any of the %Ds is greater than 20%, reanalyze the affected sample. If after reanalysis, the %D is still greater than 20%, return to Step A4, recalibrate the instrument, and repeat the procedure until the %D are within the accuracy range. If the instrument does not demonstrate accuracy %D<20% after two attempts of recalibration, call NITON service 401-294-1234.

If the %D is less than 20%, continue.

A8 If all calibration and checks are complete and within guidance, the instrument is ready for the daily analysis.

B. PRE-SAMPLE COLLECTION FOR CHARACTERIZATION

B1 Property Description

A Daily XRF Sample Log and Site Sketch Map should be prepared for the property sampled. The sampling team will fill out the top of the form, request authorizing signature (note this signature is not required but note “verbal” on the signature line if not obtained), and mark the site sketch map prior to sampling.

C. CHARACTERIZATION SAMPLING

C1 Sample Nomenclature

Each sample will be given a unique sample identification number. Samples will be identified by sequential number. Laboratory confirmation samples will have a “C” following the entire series.

C2 Sampling Locations

C2a. **Quadrant Samples**: One composite sample will be collected and analyzed separately by the XRF. One sample will be collected from one quadrant.

Each sample is composed of nine sub samples. Prior to sample collection, the nine sub sample locations must be identified and marked on the property’s Site Sketch Map. Record the sample name on the table portion of the Daily Sample Log. Be sure these nine locations are evenly spaced or spread in the quadrant or sampling zone they are representing. Do not collect a sub sample for a quadrant sample in an isolated area such as a driveway, which will be sampled separately as a potential hotspot (see C2b).

Guidelines when selecting the aliquot sampling sites for samples include the following:

- Sites will be selected at locations no closer than 5 feet from existing structures to avoid the potential influence of lead-based paint in the drip zone (the drip zone will be sampled separately).

See Step C7a for special instructions for splitting of every tenth yard sample (1 in 10).

C2b **Other Samples**: If necessary, a composite sample will be collected and analyzed by the XRF at each of the following locations:

- Concrete Floors or Floor
- Miscellaneous Non-metal Surfaces

Location and reason for sample collection will also be noted on the Daily Sample Log.

C3 **Sample Collection**

At each sub sample soil location, an aliquot of soil will be collected. If an organic layer is present above the soil, the duff, litter, grass, and roots will be removed. A small area will be excavated with a clean trowel or trier down to 1 inch into the topsoil.

C4 **Sample Preparation**

C4a Soil shall be composited from all aliquot locations in a plastic Ziploc-type bag and homogenized.

C4b Mark sample name on bag with permanent marker.

C5 **XRF Analysis**

C5a Result of the XRF analyses will be recorded on the Daily Sample Log. Three readings will be recorded for each sample and the average calculated and recorded.

C5b Shape the bag of soil to form a continuous uniform layer at least 0.5 inch thick. Do not hold the bag in your hand during testing. Do not place bag directly on a metal object during testing. **Suggestion**: Place a board between the bag and the tailgate of a truck if analysis is conducted in the field.

C5c Place the test guard on the bag.

C5d With the XRF set to Test Soil, Bulk Samples, hold the XRF with one hand.

C5e Analyze the sample 3 times in accordance with the XRF manual and record on Daily Sample Log. Calculate the average reading and record on Daily Sample Log.

C6 **Special Samples**

Every tenth sample (1 in 10) will be shipped to the analytical laboratory for confirmation analysis of by EPA Method 6010. Mark sample name on the sample container and record sample on the laboratory chain-of-custody.

D. END OF EACH DAY

Table 5 provides a checklist for the end of the day's activities.

D1 Analyze the three CVC samples – NIST reference samples Low 2709, Med 2711, and High 2710. Record all measurements on the Daily Sample Log or Log Book. Calculate the percent difference (%D) of each measured sample using the following equation:

$$\%D = \frac{|(CVC_m - CVC_s)|}{CVC_s} \times 100$$

where:

%D = percent difference
CVC_m = Measured concentration of the SVC Sample
CVCs= Marked standard concentration of the CVC sample see Table 2 for the standard concentration

If any of the %Ds are greater than 20%, reanalyze the affected sample. If after reanalysis, the %D is still greater than 20%, return to Step A4, recalibrate the instrument, and repeat the procedure until the %Ds are within the accuracy range. If the instrument does not demonstrate accuracy (%D < 20%) after two attempts of recalibration, call NITON Service – 401-294-1234.

If the %D is less than 20%, continue.

D4 Clean window with cotton swab.

D5 Download the day's results to the computer. See XRF's user's manual.

Attached Forms: Beginning of Day Checklist
End of Day Checklist
Daily XRF Sample Log
Site Sketch Map

Beginning of Day Checklist

Date______________ Time_______________ **Activity (see description below for details)**	**Complete?**	**Status**
Clean XRF window		
Allow XRF to warm up for 15 minutes		
Check instrument's date and time		
Perform internal calibration check		
Analyze CVC sample – NIST Low 2709 [calculate %D (< 20%) using the measurement and the marked concentration]		
Analyze CVC sample – NIST Med 2711 [calculate %D (< 20%) using the measurement and the marked concentration]		
Analyze CVC sample – NIST High 2710 [calculate %D (< 20%) using the measurement and the marked concentration]		
Clean XRF window		
Download data to computer and turn off XRF		

End of Day Checklist

Date_______________ Time_____________ **Activity (see description below for details)**	**Complete?**	**Status**
Analyze CVC sample – NIST Low 2709 [calculate %D (< 20%) using the measurement and the marked concentration]		
Analyze CVC sample – NIST Med 2711 [calculate %D (< 20%) using the measurement and the marked concentration]		
Analyze CVC sample – NIST High 2710 [calculate %D (< 20%) using the measurement and the marked concentration]		
Clean XRF window		
Download data to computer and turn off XRF		

Daily XRF Sample Log

Date: ____________________

XRF No.	Sample ID	Result	Units	Comments

XRF Operator ____________

Page ____ of ____

ATTACHMENT 2

PDC Laboratories, Inc.
Quality Assurance Plan

EFFECTIVE DATE: MARCH 19, 2013

REVISION 15.1 SL

PDC LABORATORIES, INC. – ST. LOUIS

QUALITY ASSURANCE PLAN

Prepared by:

PDC Laboratories, Inc. – St. Louis

Laboratory Address	Mailing Address
3278 North Lindbergh Blvd	3278 N. Hwy 67
Florissant, MO. 63033	Florissant, MO. 63033
314-432-0550 (voice)	314-432-4799 (fax)

Approved by: ______________________
Laboratory Vice-President

Date: 04-04-13

Approved by: ______________________
Laboratory Supervisor

Date: 04-08-13

Approved by: ______________________
QAO

Date: 4/8/13

Table of Contents

1.0 QUALITY POLICY STATEMENT

The mission of PDC Laboratories Inc. is to generate and report legally defensible data of know quality in a fashion that meets our clients' needs and the TNI Standard. In support of this mission, this quality assurance program has been implemented as an integral part of the laboratory management and practice.

PDC Laboratories' Quality Assurance Plan (QAP) describes the standard practices and requirements that have been established to assure the quality of the laboratories' services. It describes the implementation, management, and review of these practices. Each director, department manager, section supervisor and staff member is obligated to comply with its stated requirements, responsibilities, and objectives.

Updates and modifications to the Plan will be made as needed. The QA Department has the authority to make these changes, as well as the responsibility of verifying the adherence to technical policies and procedures. All revisions to the Plan are reviewed and authorized by laboratory management prior to their release.

John R. LaPayne 4-4-13

John LaPayne
Vice President
PDC Laboratories, Inc.

2.0 FACILITY

PDC Laboratories, Inc. duly authorized and incorporated in the State of Illinois, is a full-service environmental laboratory supporting diverse clients in the public and private sectors. The St. Louis facility is located in Eastern Missouri at 3278 North Highway 67, Florissant, Missouri, 63033, the laboratory employs a staff of approximately 25 employees. Our mission is to provide responsive service and quality results in a timely, cost-effective manner.

Normal business hours are Monday through Friday, 8:00 a.m. to 5:00 p.m. Sample Receiving hours are Monday through Friday, 7:00 a.m. to 5:30 p.m. However, general hours of analytical operation may begin as early as 6:00 a.m. and continue through the evening hours Monday through Friday. Automated analytical operations normally continue into the overnight hours and on the weekends. Emergency analytical services and extended capacity workloads will affect operating hours respective to specific project need. Some environmental services will dictate routine weekend operating hours with time and personnel requirements dependent on the service needed.

The current facility was completed in April 2006 and consists of over 11,000 square feet of laboratory and general offices. Ample bench space is provided for analysts and instrumentation, as well as space for the necessary supplies, sample storage and archives. The facility is secured by the access to the facility only through the main office or login doors. Visitors, who need to go beyond the main reception area, the sample receiving area or the shipping area are required to sign a register log in order to gain entry to the rest of the facility. This log contains such information as name, time in, time out and the person to be seen. With the exception of pre-registered "Contractors", any visitor must wear a "Visitor" tag while in the facility unless escorted at all times.

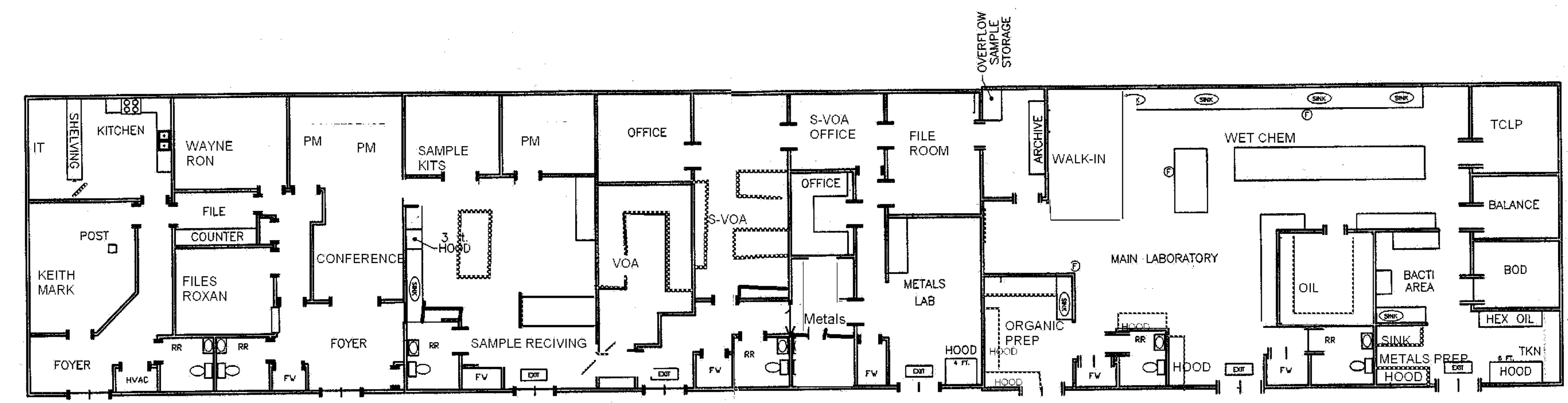
The facility houses five separate zoned laboratory areas that are served by separately controlled air handlers. Control of the escape or entrance of air borne contaminants is a result of strategic control and operation of pressure controlled areas. In addition, Organic Volatiles Instrumentation has its own ventilation systems to minimize volatile air contamination. An assortment of eight fume hoods are utilized to minimize contamination and protect the staff. The Chemical Hygiene Officer monitors the hood efficiency in accordance with Chemical Hygiene Plan.

A variety of large coolers, including a walk-in style cooler, are available for the separate storage of samples from standards, standards from reagents, and to minimize cross contamination between different sample types. Select coolers are lockable as per client contract requirements with all coolers located in secure areas.

Environmental conditions are controlled and when conditions jeopardize results (i.e. temperatures outside 60 – 75°F with condensing moisture), testing and calibration may be curtailed.

Measures are taken to ensure good housekeeping to assure that any contamination does not adversely affect data quality.

Sample waste and waste produced from the analysis of samples is segregated by wastes stream and stored in a separate waste containment area until removed by a waste disposal company. Drums containing liquid waste are stored atop liquid containment pallets.



PDC Laboratories St. Louis

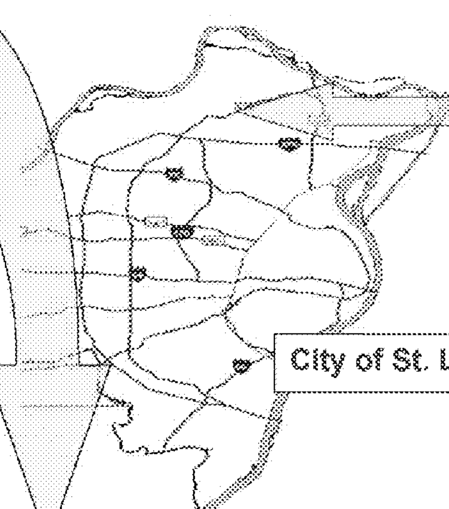
LEGEND

- Ⓕ FLOOR DRAIN (QTY. 4)
- FV FURNACE/WATER HEATER CLOSET (QTY. 5)
- RR RESTROOM

Directions to the Laboratory

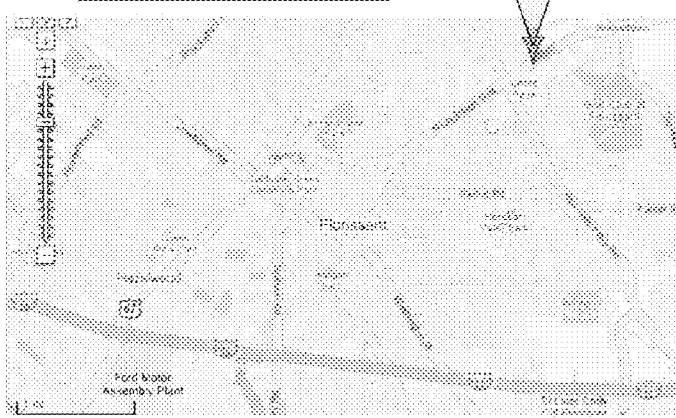
Directions to: PDC Laboratories, Inc. – St. Louis

3278 North Highway 67, Florissant, MO
314-432-0550

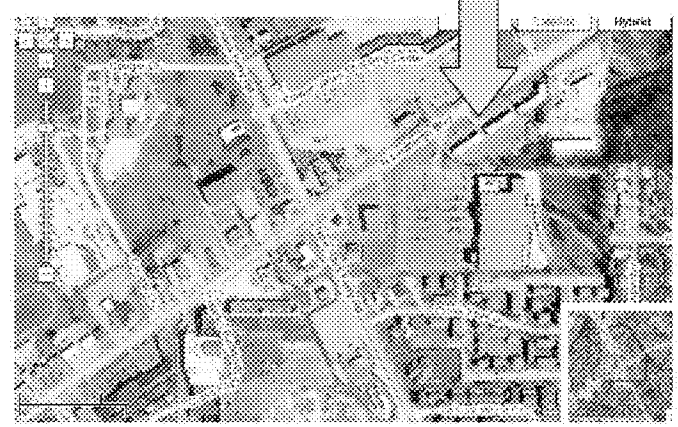


PDC Laboratories, Inc.– St. Louis is located on the north side of St. Louis in Florissant.

From North US 270 turn north on N. Lindbergh (Hwy 67) to New Halls Ferry Road.



Go past the stop light at Hwy 67 & New Halls Ferry Rd. and turn right into Lindbergh Business Center. PDC Labs is located in the center building on the lower level.



3.0 ORGANIZATION CHART AND JOB RESPONSIBILITIES

3.1 Organization Chart

The organizational structure of PDC Laboratories, Inc. – St. Louis is shown at the end of this section. A list of personnel, education, functions, and experience is included in Appendix A.

3.2 Job Responsibilities Overview

3.2.1 Vice President

This full-time senior staff member has the overall responsibility for all laboratory activities including quality assurance and chemical hygiene. The Vice President is the intermediary between the laboratory and the corporate office facilitating a two-way exchange of information between the laboratory sections and corporate management. As the Laboratory Director, the Vice President ensures the implementation of applicable corporate quality policies and the establishment, as appropriate, of additional policies, procedures and standard operating procedures (SOPs) to sustain an effective level of quality assurance. Key responsibilities include, but are not limited to, general planning, financial planning, revenue budgeting, expense budgeting, capital budgeting, designating the directors of the laboratory. Signatory approval is unrestricted as a corporate officer. The Vice President must help determine the availability of the laboratory to accept new projects. This availability includes considerations of equipment, facilities, staff, experience, etc. In the case of absence, the Vice President will designate an appropriate full-time staff member to temporarily perform this function. The Laboratory Vice-President reports to the Corporate CEO and CFO.

3.2.2 <u>Quality Assurance Officer</u>

This full-time senior staff member directs quality assurance and quality control activities and reports directly to the Vice President Laboratory Supervisor. The Quality Assurance Officer is responsible for coordinating QA/QC procedures and data review procedures for the entire laboratory, laboratory accreditations, performance testing (PT) samples, arranging external audits and conducting internal audits, maintaining a base of approved subcontract laboratories (with the assistance of the Client Services Supervisor), maintenance of the Quality Assurance Plan, the direction of the quality assurance staff, budgeting for the QA Department, and advising appropriate levels of management concerning the status of the quality system and deviations from quality program requirements. If the Quality Assurance Officer is absent for a period exceeding 15 consecutive calendar days, another full time staff member meeting the qualification of the Quality Assurance Officer shall temporarily perform this function. If the absence exceeds 65 consecutive calendar days, the primary accrediting body must be notified in writing.

3.2.3 <u>Client Services Supervisor</u>

This full-time senior staff member is responsible for the oversight of the various client services functions (project management) and reports directly to the Laboratory Supervisor. The Client Services Supervisor is the primary liaison with the marketing staff and a link between the laboratory Department Supervisors and the project managers. Client Services Supervisor is responsible for assigning clients to the various project managers. The Client Services Supervisor also helps to maintain a base of approved subcontract laboratories. Additionally, the Client Services Supervisor is responsible for ensuring that complaints are documented, investigated and resolved in a timely manner.

3.2.4 <u>Laboratory Supervisor</u>

This full-time senior staff member directs the operations of the St. Louis (Florissant) analytical laboratory and the administrative staff and reports directly to the Vice President of Laboratories. In addition to designating the operational Department Supervisors, the Laboratory Supervisor has overall responsibility for the supervision of the operational Department Supervisors, monitoring sample receipt and login, planning and coordination of analytical projects, monitoring the performance of the QA/QC activities, and overseeing the validity of the analyses performed and the data generated. Duties also include facilities management and disposal of expired chemicals. This individual assists in determining the availability of the laboratory to accept new projects and serves as the main contact for new operational personnel. This person, in conjunction with the Department Supervisors, is responsible for ensuring that operational employees maintain close adherence to laboratory procedures and accepted techniques as well as have the appropriate education or training needed to perform their duties. The Laboratory Supervisor is also responsible for the management of the hardcopy records, archival hardcopy storage and data destruction. If the Laboratory Supervisor is absent for a period exceeding 15 consecutive calendar days, another full time staff member meeting the qualification of the Laboratory Supervisor shall temporarily perform this function. If the absence exceeds 65 consecutive calendar days, the primary accrediting body must be notified in writing.

3.2.5 <u>QA/QC Coordinator</u>

The QA/QC Coordinator is responsible for the continuous development and oversight of the quality assurance program and the related quality control requirements. The QA/QC Coordinator reports directly to the Quality Assurance Officer. The Coordinator is responsible for generating and maintaining Standard Operating Procedures (SOPs), supporting the maintenance of the training files, updating method detection limit data, creation, and performing internal audits. In addition, the QA/QC Coordinator assists the Quality Assurance Officer with laboratory validations, certifications, accreditations, performance testing (PT) samples, data validation and quality control reportables, external audits and maintenance of the Quality Assurance Plan.

3.2.6 Laboratory Systems Administrator

The Laboratory Systems Administrator is primarily responsible for the management of electronic records, electronic data archival storage, operational integrity of the electronic data systems, research and development of automated laboratory information management procedures, budgeting, and staff training related to the use of the LIMS. The Laboratory Systems Administrator reports directly to the Corporate IT Manager.

3.2.7 Laboratory Information Management Staff

The Laboratory Information Management staff is responsible for computer hardware and related software utilized throughout the laboratory and report directly to the Corporate IT Manager. The activities of the LIMS staff center upon adherence to the documented requirements of the USEPA Good Automated Laboratory Practices (GALP). Key responsibilities include, but are not limited to, improving the form and function of the LIMS (Element), maintenance and backup of the LIMS and associated databases, implementation of new software and hardware, and maintaining the functionality of the LIMS. Activities of all IT staff are subject to direct review and audit by the QA Department.

3.2.8 Project Managers

Project Managers are responsible for coordinating projects with the clients and the operational Department Supervisors. Members of this staff report directly to the Client Services Supervisor. Project Managers are responsible for overseeing the specified project requirements starting with the initial client contact through the generation of the final report. In addition, Project Managers provide technical and regulatory guidance to clients, review project requests, review and approve data for final report to the client, and generate the final report for submission to the client. In conjunction with the Marketing Department, Project Managers evaluate, prepare, submit proposals as needed, and are involved in the budgeting process. Project Managers are responsible for selecting qualified laboratories for subcontract work by requesting a copy of the subcontract laboratory's quality assurance plan, a current copy of an accreditation certificate and appropriate Standard Operating Procedures if not already on file.

3.2.9 Section Supervisors (Organic, Trace Metals, and Wet Chemistry)

Section Supervisors are responsible for the operation, personnel management, financial management, and planning for the department. Section Supervisors report directly to the Laboratory Supervisor.

3.2.10 Analysts and Technicians

Analysts and technicians are responsible for producing data that meet the data quality objectives of the client, the requirements of the Standard Operating Procedures and this Quality Assurance Plan. Maintenance of a safe and clean workspace is also a primary responsibility of the Analyst. Analysts have the authority to disapprove data that fails to meet the quality assurance or quality control requirements. Any disapproved data is reported to the Section Supervisor for appropriate corrective action. These staff members are the primary element in the implementation of effective quality assurance and quality control. Analyts and technicians report directly to their Section Supervisors.

3.2.11 Courier Support Staff

The Couriers are under the direction of the Laboratory Supervisor. These staff members are responsible for the pick-up and delivery of samples from various client sites, and the delivery of approved empty sample containers to these clients, as needed.

3.2.12 Director of Field Services

The Director of Field Services is responsible for the coordination of sample collection and the actual collection of samples. The Field Sampling Services Staff are under the direction of the Director of Field Services. The Director of Field Services reports to the Laboratory Supervisor.

3.2.13 Field Sampling Services Staff

The Field Sampling Services staff is responsible for the actual collection of samples. The Field Samplers collect samples, obtain field data, and submit samples to the laboratory in accordance with the PDC Laboratories, Inc. - St. Louis General Groundwater Sampling Plan or other applicable client or site-specific plan. Field Sampling Services staff report to the Director of Field Services.

3.2.14 Login/Shipping/Receiving Staff

The responsibilities of this staff includes sending approved sample containers to the clients, receiving and inspecting samples after delivery to the laboratory, logging samples into the LIMS, and storing and organizing in-house samples. The staff members responsible for login, shipping, and receiving report to the Client Services Supervisor and are under the ultimate direction of the Laboratory Supervisor.

3.2.15 Office Manager

The Office Manager is responsible purchasing, human resources, contract/quote review, coordination of facility maintenance, health & safety, and assists in marketing and administration of the St. Louis facility. The Office Manager reports to the Laboratory Supervisor.

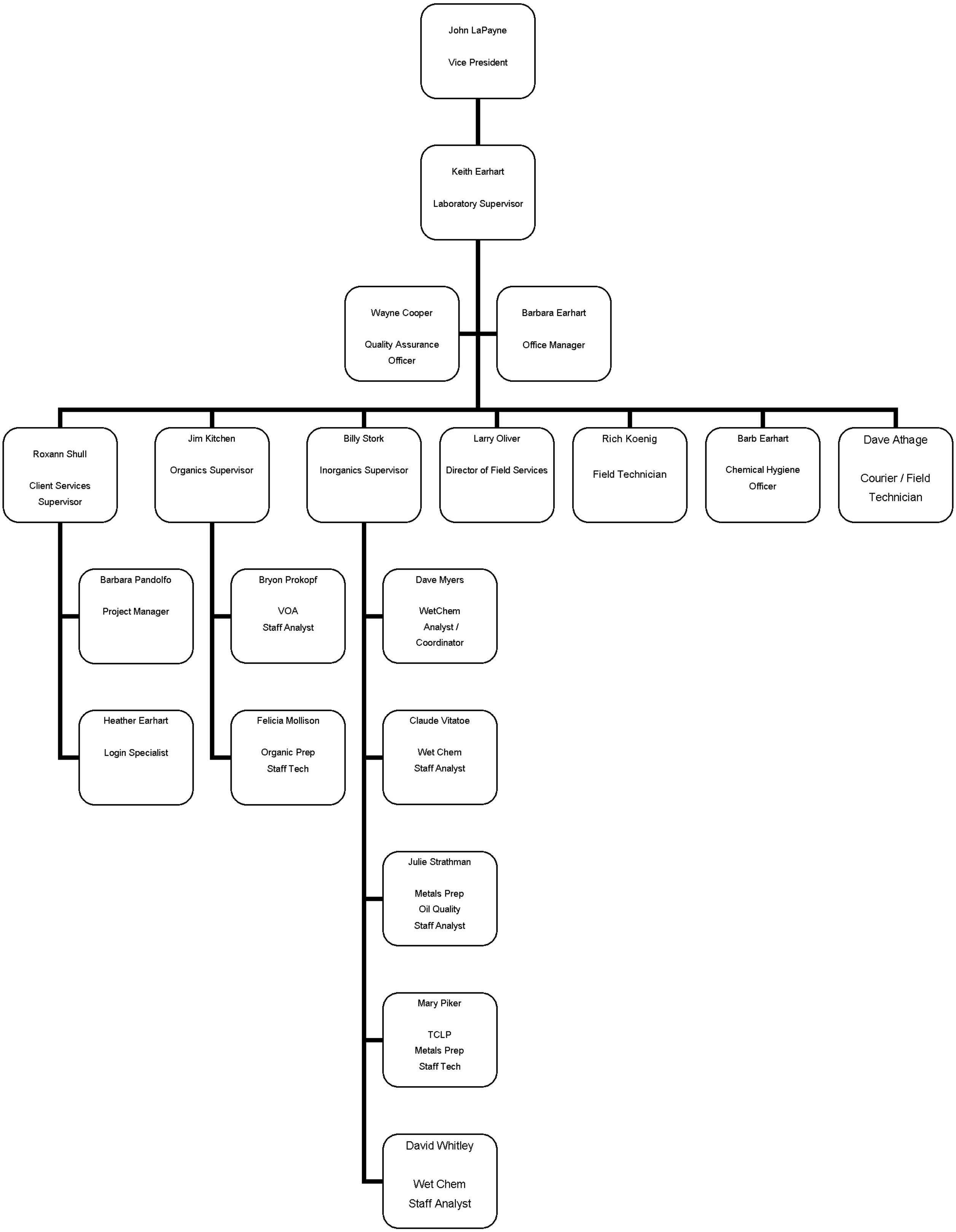
3.2.16 Administrative Professional Staff

The Administrative Professional Staff is responsible for routine office activities. These activities include, but are not limited to, reception, specialized report generation, data entry, submitting reports to the client, electronic data deliverables, copying, filing, document generation and invoicing. The Administrative Staff members scan finished reports for electronic storage and retrieval, as well as maintaining the document form master library for laboratory bench sheets/data entry forms, inter-company correspondence, and staff memos. Staff members report to the Office Manager.

3.2.17 Chemical Hygiene Officer

The Chemical Hygiene Officer (CHO) reports directly to the Laboratory Supervisor. The CHO develops and implements appropriate chemical hygiene policies and practices, monitors the procurement, use, and storage of chemicals used in the laboratory, conducts appropriate audits to review and evaluate the effectiveness of the chemical hygiene plan, and knows the current legal requirements concerning regulated substances.

PDC Laboratories, Inc. – St. Louis
Organizational Chart for 2013



4.0 <u>QUALITY ASSURANCE / QUALITY CONTROL</u>

4.1 General QA/QC Responsibilities

A Quality System is defined as a structured and documented management system describing the policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an organization for ensuring quality in its work processes, products (items), and services. The quality system provides the framework for planning, implementing, and assessing work performed by the organization and for carrying out required quality assurance and quality control.

Quality Assurance (QA) refers to those activities whose purpose is to provide the producer or user of a product or service the assurance that it meets defined standards of quality with a stated level of confidence. QA practices do not guarantee the quality of the data, per se, but create an environment where a certain level of quality of the data is anticipated.

Quality Control (QC) refers to those activities whose purpose is to control the quality of a product or service so that it meets the needs of users. These activities include the quality control tests performed by the analysts.

The purpose of this Quality Assurance Plan is to document the program through which PDC Laboratories, Inc. - St. Louis generates and reports data of known quality. Properly understood, quality assurance begins before the sample containers are sent to the client and continues after the data is archived. The goal of this quality assurance program is to create and maintain an unequivocal sample history to verify the sample receipt, validity of the analysis, and report of the analytical data.

The requirements in this Quality Assurance Plan are written to address the programs or practices for all types of samples received. In cases where samples are received for compliance to the USEPA Contract Laboratory Program (CLP), the U.S. Army Corps of Engineers Missouri River District, or other contracted program-specific Quality Assurance Project Plans, PDC Laboratories, Inc. - St. Louis will handle, prepare, and analyze samples, as well as report sample results in strict accordance with those program requirements and the client data quality objectives (DQOs). Samples are also analyzed under varying specific state programs under which the laboratory maintains certification. PDC Laboratories' client base includes municipalities, industries and consultants requiring analyses for various regulatory programs as well as individuals having samples analyzed for their own particular needs. The quality control requirements for these clients will be met under the National Environmental Laboratory Accreditation Conference (NELAC) program unless specified under another program. In addition to this work, PDC Laboratories, Inc. - St. Louis serves clients who need to meet certain contract requirements and/or data quality objectives. These quality control requirements may require additional quality control elements in addition to the "standard QC". These cases are identified within this QA Plan as text in ***bold italic*** print.

It is the responsibility of each individual laboratory staff member to learn and follow the appropriate procedures in their day-to-day activities. This accountability emphasizes that quality is <u>everyone's responsibility</u>, from the support staff to the analysts, to the supervisors, and to the managers and directors. While directors and managers can delegate specific duties and authority to their employees, this does not relieve them from their accountability for the function or actions of their designee. Personnel at all levels are responsible for identifying quality issues or potential quality issues and initiating corrective action to solve the problem and prevent reoccurrence.

4.2 <u>Managerial Review of the Quality Systems</u>

Annually, the laboratory's Senior Staff (Vice President, Quality Assurance Officer, Laboratory Supervisor, Organics Supervisor, Inorganics Supervisor, Client Services Supervisor, and Office Manager) shall hold a meeting to conduct a review of the laboratory's quality system and environmental testing activities to ensure their continuing suitability and effectiveness and to discuss necessary changes or improvements.

The review shall take account of the following items:

- the suitability of policies and procedures,
- reports from managerial and supervisory personnel,
- the outcome of recent internal audits,
- corrective and preventative actions,
- external audits,
- the result of proficiency testing,
- changes in the volume and type of work,
- client feedback/complaints, and
- other relevant factors, such as quality control activities, resources and staff training.

In addition, during this meeting, any additions or modifications to the Quality Assurance Plan will be proposed and discussed. Following review and approval by the Senior Staff, the QAP will be amended by the Quality Assurance Office and approved by the Laboratory Vice President, Laboratory Supervisor, and Quality Assurance Officer. These revisions and approvals are documented through signature on the title page of the QAP.

Findings from the management review and actions that arise from them shall be documented with Corrective Action/Quality Improvement Reports. The Senior Staff shall ensure that those actions are carried out within an appropriate and agreed upon timeframe. Business-related timeframes (i.e. updating phone systems) may be set for an extended period of time and reviewed and possibly extended on or before the completion date. A summary of the outcome of these findings will be documented in the next year's Managerial Review Report.

5.0 DOCUMENT CONTROL

All documents issued to appropriate personnel in the laboratory as part of the quality system shall be reviewed and approved for use by authorized personnel prior to issue. A master list identifying the current revision status and distribution of documents shall be established and be readily available to preclude the use of invalid and/or obsolete documents. The Quality Assurance Department maintains master copies of the raw data forms. Quality System documents shall be uniquely identified. Such identification shall include the date of issue and/or revision identification, page numbering, the total number of pages or a mark to signify the end of the document, and the issuing authority (ies). Documents are periodically reviewed. Changes shall be reviewed and approved by the Quality Assurance Department. A revised document shall be re-issued as soon as practicable and obsolete documents will be removed from all points of use. Obsolete documents must be marked and retained. Modifications/revisions of documents should be documented in the SOP section ‘Modifications’.

The record keeping system must allow historical reconstruction of all laboratory activities that produced the analytical data. The history of the sample must be readily understood through the documentation.

Laboratory raw data is maintained in the form of computer-generated data reports stored on digital media or as hand-written entries in pre-printed data logbooks or notebooks.

Computerized printouts must contain, at a minimum, laboratory name, analytical method, information relating to laboratory sample number, date of analysis, and analytical data. At a minimum, analytical data includes instrument identification, analyst initials, date and time of analysis, calibration data, and analyte concentrations. These printouts are maintained chronologically in binders or project file folders, and storage boxes designated for each individual instrument.

For analytical methods that do not have instrument printouts, all data entries and calculations are manually entered into analysis logbooks. A separate logbook is maintained for each analytical procedure. Information entered into these logbooks is the same as that required for the instrument printouts. These logbooks shall be dated and signed/initialed by the person performing the activity at the time the activity was performed. All dates recorded must include month/day/year (MM/DD/YY or MM/DD/YYYY). All times must be recorded using military time (24-hour clock). All logbook entries shall be in chronological order. All entries shall be recorded promptly and legibly in permanent ballpoint black ink (other ink colors or pencils are forbidden). **Sharpies® or any other kind of permanent marker (felt-type, gel-type pens) are strictly prohibited.** Unused portions of a logbook page shall be "z'd" or lined out and initialed and dated so that additions after the sign-off date cannot be made. Each logbook for manual data entry shall be bound. All pages of bound logbooks shall be sequentially numbered. Pages shall not be removed from sequentially numbered bound notebooks. Data entry fields must be filled out individually or if the same, an arrow-down may be used.

The cover of the binder shall include the laboratory name, unique name/purpose of the logbook, logbook number, the "open"/ "close" date and area in which the test was performed.

Final reports are spooled and saved as PDF files in [Promium LIMS SQL Server]/PDF/Work.

Quotations for current clients are generated through Element™ and stored as pdf files on [STLSERVER]/Environet/Fees. Quotations for new clients are generated through Microsoft Word and stored on [STLSERVER]/Environet/Fees. Original returned and signed contracts and are maintained in file cabinets in the Administrative Department. Client invoices are scanned and saved as pdf files on [OptimusPrime]/Administration/Invoices.

After a minimum of one year, records are moved to permanent archive storage for a total minimum of five years. This long-term archive storage is provided in an on-site secure warehouse. Laboratory records include results and supporting documentation from the analysis of PT samples, project specific QA plans, project correspondence, sampling records (if received), chain-of-custody records, shipping documents, analytical data including calibration and quality control, project specific logbooks, data exception reports, and final reports. Archived Standard Operating Procedures (SOPs) are maintained in the QA/QC Coordinator's Office. All laboratory records are accessible to auditing agencies. Access to the archived records is documented through the use of an access log as per the provisions of the SOP, HARDCOPY RECORD STORAGE, RETRIEVAL and DISPOSAL.

5.1 Error Correction - Data

When laboratory raw data must be changed after the initial recording, the changes must be performed in a fashion that preserves the original result as well as indicating the change, reason for the change, who made the change and when it was made. Error correction to raw data shall include a single line through the original data, the initials of the analyst making the correction, the date (month-day-year) performed, and a note of explanation if warranted. The original entry must remain legible. Writing over or 'scribbling' an incorrect entry, using WhiteOut® (or similar product) or erasing the entry is strictly prohibited on laboratory documentation. Failure to comply with the proper procedures will result in disciplinary action.

5.2 Error Correction - Reports

When corrections to a final report must be made after the original submission to the client the changes must be performed in a fashion that preserves the original result as well as indicating the change, reason for the change, who made the change and when it was made. The LIMS is compliant with the USEPA Good Automated Laboratory Procedures (GALP) and documents these requirements when the Data Audit Trail function is properly used. All corrections to originally reported data must be made in accordance with this function. If a corrected report is generated, this report must be labeled as a "Revised report" or similar identification. Clients must be notified of a revised or amended report as soon as possible.

6.0 STANDARDS AND REAGENT TRACEABILITY

All standards and reagents must be tracked from their initial preparation through their use in the analytical batch. Standards purchased from an outside vendor must be traceable to the National Institute of Standards and Technology (NIST). A Certificate of Analysis, or other document of traceability, is kept in the appropriate standards documentation file in the appropriate section. If a certificate is unavailable, a copy of the information on the vial or container will be kept (i.e., SARMS standards) on file. The date of receipt, the date of opening, and the expiration date will be noted. An independent verification against known standards will be made, if necessary. Purchased traceable standards may be used at their prepared and labeled concentration without further verification. Appropriate standard sources are obtained where verification of the calibration must be performed by a second source standard.

All standards, reagents, and preparations are maintained in Promium Element™.

Each stock standard, subsequent dilution and prepared reagent is given a unique tracking number by Element™. This number allows traceability back to the NIST certified value or reagent lot. When preparing dilutions of a standard the following information must be included in the standards log: standard source lot number, standard name, expiration date, initials of the preparer, date prepared, and detailed information of the volume/mass used, final volume prepared, diluent, and prepared concentration. Similar information must be recorded for any prepared reagent. The documented information must be sufficient to allow traceability to the preparation record, which provides traceability of all ingredients. The expiration date of a prepared standard is that date on which the stock solution expires. In mixes where there is more than one expiration date for the stock solutions, the earliest date is chosen as the expiration date for the entire mix. The standard is valid for that length of time only if evaporation is minimized and proper preservation and storage techniques are used. Reagents must be of analytical reagent (AR) grade or better. Each container shall be labeled with standard or reagent name, concentration, tracking number, and the expiration date. If the container is too small for a label with the required information, the container must be labeled with the Element® reference number and expiration date. Expired standards must be discarded or, if retained, labeled "For Research Only". Expired standards cannot be used for the generation of analytical data. The preparation of standards shall be performed with glassware and delivering devices of known and acceptable accuracy. Unless specified in the method, reagents are used until they are found to not produce the expected response.

Prepared titrants must be verified before use.

Solutions are always poured off from the original bottle and unused portions are never returned to the original bottle. If degradation becomes apparent the solution is discarded immediately and holding times are reduced.

The quality of standards and reagents should be verified prior to use by comparing the bottle label with the quality defined in the SOP.

Care must be exercised to store standards under appropriate conditions.

7.0 STANDARD OPERATING PROCEDURES

PDC Laboratories, Inc. - St. Louis utilizes a wide variety of published analytical methods approved for use by various regulatory agencies. Sample matrix type or the client's data quality objectives often dictate the method of choice as well as contract requirements or conditions of certification. A summary list of methods performed by the laboratory is included in Appendix K. In cases where modifications to the published method have been made or where the referenced test method is ambiguous or provides insufficient detail, these changes or clarifications have been clearly described in laboratory-generated standard operating procedures.

A Standard Operating Procedure (SOP) is a set of written instructions that provide guidance or document a routine or repetitive activity followed by an organization. The development and use of SOPs are an integral part of a successful quality system as it provides individuals with the information to perform an activity properly, and facilitates consistency in the quality and integrity of a product or end-result.

Laboratory specific Standard Operating Procedures (SOPs) have been developed for each analytical procedure. As controlled documents, the SOPs are uniquely numbered and tracked by revision number and date. Each analytical SOP is in the following format:

I. Identification of the Method
II. Signatory Section
III. Applicable Matrix or Matrices
IV. Units of Detection and Quantitation
V. Scope & Application
VI. Summary
VII. Definitions
VIII. Interferences
IX. Safety
X. Equipment & Supplies

XI. Reagents & Standards
XII. Sample Collection, Preservation, Holding Times, Shipment & Storage
XIII. Quality Control/Corrective Action and Contingencies for Out-of-Control Data
XIV. Calibration and Standardization
XV. Procedure
XVI. Additional Corrective Action and Contingencies for Out-of-Control Data
XVII. Calculations
XVIII. Method Performance
XIX. Pollution Prevention
XX. Waste Management
XXI. References
XXII. Tables, Diagrams, Flow Charts, Validation Data
XXIII. Revision Record
XXIV. Addendums

Non-analytical Standard Operating Procedures (SOPs) have been developed for each laboratory activity center – Administration, Facility Management, Information Technology, Project Management, Quality Assurance, and Shipping/Receiving. As with the analytical SOPs, these SOPs are uniquely numbered and tracked by revision number and date. Each non-analytical SOP is in the following format:

I. Purpose
II. Scope
III. Procedure
IV. Tables, Attachments, Etc.
V. Signatory Section

It is the responsibility of each section supervisor, department manager, and director to ensure that the analysts or individuals performing the referenced activity are following the SOP. Each employee must certify that the SOPs have been read, understood, and agree to follow the most recent version of the SOP. The signed certification is kept on file in the training manual. Disciplinary action may result from failure to follow the SOPs as written.

Current copies of the SOPs are readily accessible for reference in the work areas of those individuals actually performing the activity. SOPs are reviewed and updated when needed based upon considerations such as updated methods, technology, etc. by one or more individuals with appropriate training and experience with the process. Signature approval indicates that a SOP has been both reviewed and approved by management. A list of the current analytical SOPs is retained at the laboratory. The original, signed SOP is filed in the QA Coordinator's office and copies are issued on color-coded paper indicating the current revision. Copies of the current SOPs are available to all analysts, and to clients upon request.

8.0 PROJECT ASSESSMENT AND MANAGEMENT

The project management team is responsible for assisting clients in the administration of their sampling and analysis programs. Projects are assessed and assigned to specific project managers based on the general nature of the work. Typically, projects are categorized as municipal wastewater, municipal drinking water, industrial waste, industrial wastewater, groundwater, clean-up and remediation, subcontracted laboratory samples, homeowner ("private clients"), paperboard, transformer oil, or samples in accordance with Federal contracted program-specific requirements.

8.1 Project Assessment

The initiation of a new project occurs when a project manager receives a request from a client (current or potential). The project manager responsible for that market segment is allowed to use discretion in accepting work that is of a routine nature for PDC Laboratories, Inc. - St. Louis after checking laboratory capacity. Quotes may be prepared by project managers, sales representatives, or corporate officers. Client contracts must be signed by a corporate officer such as the Vice-President of the laboratory.

Non-routine projects are routed through the Client Services Supervisor, Quality Assurance Officer, Laboratory Supervisor, and the appropriate Department Supervisor in order to determine feasibility. Method development requires a consulting fee assessment as well as cost/time fees in addition to normal charges.

8.2 Project Management

Proper setup is essential for the success of a project. Once a project is assigned to a project manager, this individual has the responsibility for the following:

- Informing the client of the PDC Laboratories, Inc. - St. Louis Sample Acceptance Policy
- Obtaining project specific requirements regarding data quality objectives or regulatory requirements, turn-a-round times, number of samples, matrix, analytes, methods, reporting limits, quality control, evidentiary requirements and report requirements (QC summary forms, CLP-like forms, narratives, etc.)
- Obtaining a current copy of the QAPjP (Quality Assurance Project Plan), if required
- Setting-up the account information in the LIMS
- Setting-up Bid/Project templates in the LIMS
- Arranging the delivery and receipt of sample containers
- Informing applicable operations staff of non-routine requests
- Oversight of the sample login
- Monitoring sample progress in the laboratory
- Report generation
- Project inquiries by the client
- Reporting any potential problems to the client in a timely fashion

All correspondence between the client and the laboratory that establishes or modifies what is to be done on a project must be documented and retained. Formal requests and subsequent responses are filed in unique client or project specific files. Various forms of documentation may be used on a given project. Project modifications may be documented by placing comments on the chain-of-custody (COC) form, memos placed in the files, or comments placed in the LIMS. Project Managers are responsible for timely communication with the laboratory staff where there are changes in project requirements. Project managers are encouraged to use telephone logs to document their verbal discussions with clients; however, any form of written documentation such as email is acceptable.

9.0 QUALITY CONTROL

Quality Control (QC) refers to those activities whose purpose is to monitor the quality of a product or service so that it meets the needs of users. These activities include the quality control tests and measurements performed by the analysts in order to produce data of known quality that satisfies project objectives and that meet or exceed the requirements of the standard methods of analysis. This program provides a mechanism for on-going control and evaluation of data quality measurements through the use of QC materials.

The performance of all analytical methods must be monitored to assess the accuracy and precision of the procedure. Specific quality control checks are designed to provide the necessary information for method assessment.

9.1 Elements of Quality Control – Chemical

The basic quality control unit is the preparation batch. A preparation batch is composed of one to 20 environmental samples of the same matrix, that are prepared together using the same process and personnel, utilizing the same lot(s) of reagents. The minimum time between the start of processing of the first and last sample in the batch is 24 hours. Laboratory QC samples (e.g. blanks and laboratory control samples) shall be included in the preparation batch with the field samples. Matrix spikes and matrix spike duplicates are not counted as environmental samples. However, matrix spikes and matrix spike duplicates may be counted as billable environmental samples in certain contracted program-specific project plans such as the USEPA Contract Laboratory Program (CLP) or the U. S. Army Corps of Engineers.

The term analytical batch is used to define a batch of samples that do not need a separate extraction, digestion, or distillation (e.g. volatiles by purge-and-trap and titrations) as well as those samples that have been previously extracted, digested, and/or distilled. The identity of each batch shall be unambiguously reported with the analyses so that a reviewer can identify the QC samples associated with a group of samples.

The applicability of each of the following QC elements is listed in the appropriate analytical method. The specifics regarding frequency, acceptance criteria, and corrective action are included in the respective analytical SOPs.

9.1.1 Tuning

Instrument tuning is performed prior to calibration in order to assure that the instrument will produce results equivalent to similar instruments in other laboratories. This procedure is specific to GC/MS.

9.1.2 Calibration

Analytical instruments are calibrated prior to sample analysis in accordance with the referenced analytical methods in order to establish the working range of the instrument. All specific target analytes are included in the initial and continuing calibrations. All standards used during calibration must be referenced by its unique tracking number (section 6.0).

If calibrations do not meet the acceptance criteria stated in the relevant SOP, an option to narrow the range of the curve either by eliminating the low point or high point of the curve can be considered providing all project criteria are still met. For multi-analyte calibrations, specific analytes may be eliminated from the low or high points. Otherwise, the entire calibration curve must be repeated. Elimination of any of the inner levels of the calibration in order to meet QC acceptance criteria is allowed provided that all analytes are eliminated in that level. Care must be taken to ensure that required reporting limits are still met if a low level standard is removed and that the required number of standards for the calibration to be valid is analyzed.

9.1.3 Retention Time Windows

Retention time windows are used in GC, IC, and HPLC analysis for qualitative identification of analytes. They are calculated from replicate analyses of a standard on multiple days.

9.1.4 Initial Calibration Verification (ICV)

A second source standard containing all target analytes is analyzed immediately after each initial calibration curve to verify that the calibration standards are of the correct concentration and that the initial calibration is accurate.

9.1.5 Initial Calibration Blank (ICB)

A reagent blank is analyzed immediately after the ICV and prior to the analysis of environmental samples to assure that any contamination of the analytical process will be detected, if present (inorganics only). A blank may also be analyzed in the event saturation-level concentrations are incurred to demonstrate that carryover contamination does not exist.

9.1.6 Interference Check Sample (ICS)

The interference check samples (solutions A and AB) are used in inductively coupled plasma analyses (ICP) calibrations. This QC sample contains, both, interfering and analyte elements at known concentrations. The ICS is used to verify background and interelement correction factors and is analyzed at the beginning and end of each analytical batch.

9.1.7 Method Blank (MB or BLK)

The method blank is used to document possible contamination during the analytical process. The method blank shall consist of a matrix that is similar to the associated samples and is known to be free of the analytes of interest. The method blank shall be processed along with and under the same conditions as the associated samples to include all steps of the analytical procedure. This QC sample may also be known as a procedural blank (PB).

9.1.8 Laboratory Control Sample (LCS or BS)

The LCS is prepared with analyte-free water (for aqueous analyses) or Ottawa sand (for organic soil analyses) spiked with representative analytes. The LCS shall be spiked at a level less than or equal to the midpoint of the calibration curve for each analyte. This QC sample shall be carried through the entire preparatory and analytical procedure. The LCS is used to assess control of the analytical process.

9.1.9 Matrix Spike / Matrix Spike Duplicate (MS/MSD)

The matrix spike and matrix spike duplicate are aliquots of sample spiked with known concentrations of representative analytes. The spiking occurs prior to sample preparation and analysis. The MS and MSD shall be spiked at a level less than or equal to the midpoint of the calibration curve for each analyte. The MS/MSD is used to assess the bias of a method due to sample matrix; however, the MS/MSD is not used to assess control of the entire analytical process.

9.1.10 Duplicates (DUP)

Duplicate samples are separate aliquots analyzed simultaneously or in immediate succession, using identical preparatory techniques, and treated in an identical manner. Duplicate sample results are used to assess precision of the entire analytical process.

9.1.11 Post-digestion Spikes (PDS)

A post-digestion spike is analyzed for unusual matrices analyzed by ICP, GFAA, or CVAA, or used as a troubleshooting tool. The spiking solution is added to the same sample from which the MS/MSD aliquots were prepared just prior to analysis thereby evaluating only the analytical process and not the preparation. If the spike fails, then a serial dilution should be run on this sample. If both the MS/MSD and the post digestion spike fail, then matrix effects are confirmed.

9.1.12 Serial Dilution (SD)

A serial dilution of a sample is analyzed for unusual matrices analyzed by ICP, GFAA, or CVAA, or used as a troubleshooting tool in conjunction with a PDS. The serial dilution is used to determine if a chemical or physical interference effect is present. This dilution, made at a ratio of 1:5, may be necessary if analyte(s) are sufficiently high (i.e. greater than 1000 times the instrument detection limit).

9.1.13 Method of Standard Additions (MSA)

MSA is a method for the correction of interferences as evidenced by the failure of the MS and PDS. This technique may be used to compensate for a sample constituent that enhances or depresses the analyte signal. Usually applicable to trace metals analyses.

9.1.14 Continuing Calibration Verification (CCV)

A standard is analyzed to verify that the calibration remains valid. A primary or secondary source standard may be used. For inorganic and trace metals, the analysis of the CCV is required after every 10 samples and at the end of each analytical batch. For organic analyses, the CCV is required at the start of each day, every 12 hours, and after every 10 samples throughout the analytical batch if required by the method.

9.1.15 Continuing Calibration Blank (CCB)

A reagent blank is analyzed after the CCV (inorganics only). A blank may also be analyzed in the event saturation-level concentrations are incurred to demonstrate that carryover contamination does not exist.

9.1.16 Surrogates (SUR)

Surrogates are compounds not expected to be found in environmental samples that are used to evaluate accuracy, method performance, and extraction efficiency in organic methods. Surrogates are added to environmental samples, controls, and blanks in accordance with method requirements.

9.1.17 Internal Standards (ISTD)

Internal standards are used in organic analyses and metals analyses (ICP, and ICP/MS) to generate calibration response factors and to correct sample results affected by column injection losses, purging losses, or viscosity effects. When used, these compounds are added to every environmental sample, quality control sample, and blank.

9.1.18 Estimation of Uncertainty of Measurement.

Estimation of uncertainty of a measurement is set of procedures used to assess the margin of doubt associated with an analytical result. An example of reporting the uncertainty would be as follows: “the ‘true value’ is 39.1±0.3°C with 95% confidence”. The procedures for the estimation of measurement uncertainty are described in SOP-GEN-EstMeasUncert.

9.2 Elements of Quality Control – Microbiological

The following elements apply only to the analyses performed in the microbiology laboratory. These elements are vital for the generation of accurate and acceptable data in accordance with Standard Method for the Examination of Water and Wastewater. These elements are in addition to or take precedence over similar requirements found in other sections of this Quality Assurance Plan.

9.2.1 Blanks

These blanks are applicable to the membrane filtration technique. A blank (100 mL of sterile dilution water) is set at the beginning and end of each batch with additional blanks every 10 samples.

9.2.2 Analyst Quality Control

Each certified analyst will quarterly count a count comparison plate or tray for each method.

9.2.3 Lot Comparisons

The following supplies are tracked by manufacturer lot number. Before a new lot can be used, membrane filters must be compared against the previous lot and found not different using the Student's t-test. Disposable volumetric containers, pipettes, etc must be checked for use volumes at least once per batch lot. Unacceptable lots cannot be used in the analysis of samples.

9.3 Support Equipment – Chemical and Microbiological

Reference standards (such as class S weights and NIST thermometers) are only to be used for calibration unless it can be shown that their routine use will not degrade their performance as reference standards.

Support equipment that is received precalibrated/prevalidated may be placed in service until the next required calibration/validation date.

Raw data records for support equipment must be recorded and maintained in logbooks. Where necessary (i.e. thermometers) correction factors will be applied and recorded in these logbooks and with a device related tag.

9.3.1 Glassware - Chemical

Borosilicate glassware is used whenever possible. Volumetric glassware must meet the requirements of ASTM Class A glassware. Volumetric glassware shall not be used for the preparation of solutions that result in an exothermic reaction, not heated or for the storage of reagents and standards. In addition, the accuracy of all nonstandard lab ware (K-D tubes, Zymark® tubes, plastic cups, centrifuge tubes, etc.) used to measure initial sample volume, prepare dilutions, or measure the final volume of extracts/digestates must be verified and documented.

9.3.2 Sample Containers – Microbiological

One piece of cleaned glassware per washed and prepared lot shall be checked with bromothymol green indicator for alkaline or acidic residues. If the check fails, all glassware in the wash batch must be re-rinsed or rewashed/ rinsed and rechecked. The process is repeated until the check passes.

Annually and after each change of detergent lot, the Inhibitory Residue Test will be performed to evaluate glassware wash and rinse techniques. Tests failing this check indicate inadequate wash/rinse procedures that require modification before cleaning may continue.

One container from each lot of sterilized sample containers is used to verify sterility using tryptic soy broth and a second container is used to verify sufficient de-chlorination. Unsatisfactory sterility results require that all containers from the failed lot must be re-sterilized and/or re-washed, sterilized, and re-tested until satisfactory results are achieved.

Sample containers are purchased pre-sterilized containing sodium thiosulfate.

9.3.3 Laboratory Water - Chemical

The laboratory water meets or exceeds ASTM Type II Reagent Grade Water requirements. The laboratory water system is designed with a pretreatment system that includes softening, organic removal, and ion removal. The scheduled maintenance of the water purification process prior to final point of use purification is detailed in 'SOP #900SL-DI WaterQual'. Maintenance of the pretreatment system is documented when performed. Measurements of resistivity are performed daily and documented for each system in the laboratory. Acceptance criterion is greater than 1.0 $M\Omega \cdot cm$.

9.3.4 Laboratory Water - Microbiological

The resistivity of the microbiology laboratory water is measured monthly. Acceptance criterion is greater than 0.5 $M\Omega \cdot cm$. Monthly checks of the microbiology laboratory water system must also verify that total residual chlorine is not detectable, and heterotrophic plate count is less than 500/mL. Annually, microbiology laboratory water must indicate the concentrations of cadmium, chromium, copper, lead, nickel, and zinc are less than 0.05 mg/L each (and <0.1 mg/L combined), and that the bacteriological suitability ratio is between 0.8 and 3.0.

9.3.5 Balance Masses

Class S-1 masses are used to check balances for accuracy and precision. These masses are recertified every 5 years and records including associated uncertainty measurements and/or a statement of compliance with an identified metrological specification must be retained.

9.3.6 Thermometers

Traceable NIST reference thermometers are used to check the thermometers used throughout the laboratory. The traceable thermometers are recertified annually and records including associated uncertainty measurements and/or a statement of compliance with an identified metrological specification must be retained.

9.3.7 Balances – Chemical / Microbiological

Balances are calibrated or verified by PDC Laboratories Inc. staff each day of use.

Acceptance criteria for verification are $\pm$5 times the readout sensitivity (e.g. a balance reading to 0.01g has criteria of $\pm$0.05g). Annually, all balances are serviced, cleaned and calibrated/verified by a third party contractor.

9.3.8 pH Meters

pH meters have a minimum of 0.01 unit sensitivity. Automatic Temperature Compensating (ATC) probes are used to negate the effects of temperature differences between the standards and samples. The meters are calibrated each day of use with a minimum of 2 buffers. Initial and continuing verifications are required. Acceptance criterion is $\pm$0.1 unit.

9.3.9 Specific Conductance Meters

Specific Conductivity meters have a sensitivity of $\pm$10% or $\pm$1 umhos/cm, whichever is greater. The meters are calibrated with each use. Initial and continuing verifications are required. Acceptance criteria are of $\pm$10% or $\pm$1 umhos/cm, whichever is greater.

9.3.10 Thermal Devices

All ovens, coolers, water baths, and incubators are monitored on a daily basis. The temperatures of all ovens and water baths are documented logbooks or preparative worksheets. The temperatures of all coolers, and incubators are recorded in logbooks each working day and corrective action taken and documented as needed. Incubators used for BOD analysis are monitored daily. Incubators (each shelf) and water baths for microbiology are monitored twice daily, at least four hours apart. Daily temperature logs document the laboratory name, thermometer ID, oven/cooler/etc. ID, date, temperature, acceptance range, corrective action, and initials of the person measuring the temperature. The thermometers used are verified annually against a NIST traceable thermometer. The appropriate correction factor is applied to all thermometer readings. Thermometers with a correction factor greater than 1°C will not be used in the laboratory.

9.3.11 Autoclave – Microbiological

A spore ampule is analyzed monthly and the results documented in order to confirm the sterilization effectiveness.

Records of autoclave operation are maintained for each cycle. These records will include: Date, contents, sterilization time, max temperature indicated by a min/max thermometer, pressure, result of heat indicating tape, analyst's initials.

A temperature/pressure check (121°C/15psi) is performed and documented annually.

The autoclave timing device will be checked quarterly against a stopwatch and documented.

9.3.12 <u>Pipetters and Disposable Pipets - Chemical / Microbiological</u>

The delivery volume of Eppendorf® style pipetters is verified and documented prior to initial use and on a quarterly basis. Acceptance criteria are listed in the SOP, <u>Gen-PipetCal</u>. Equipment not meeting the acceptance criteria is not used in the laboratory. Repippeters are verified on quarterly basis.

Each lot of disposable pipets will be checked and documented before use.

9.3.13 <u>Nephelometers</u>

Nephelometers used to measure turbidity are calibrated each day of use. Initial and continuing calibration verifications are performed and documented. The acceptance criterion is 90 to 110% recovery.

9.3.14 <u>Spectrophotometers</u>

The wavelength accuracy of spectrophotometers is verified during each startup cycle.

9.3.15 <u>TCLP Tumblers</u>

The rotation rate of the tumbler units used for the Toxicity Characteristic Leaching Procedure (TCLP) and other such procedures is verified prior to use on a weekly basis. The acceptance criterion is 30 $\pm$ 2 rpm. This check is documented and any units not meeting the acceptance criterion are removed from service.

9.4 <u>Sample Containers</u>

Select containers are purchased certified clean from a commercial vendor. These containers are ready for use and require no additional monitoring prior to use. Certificate of Analysis are maintained by the Login Specialist. Containers that are purchased “clean” but not certified, as well as bottles that are washed at PDC Laboratories, Inc. - St. Louis, must be verified clean prior to shipment to clients.

A representative bottle(s) from a given lot of cleaned bottles is filled with laboratory pure water and applicable preservative, and then submitted to the login department. The sample is logged into the LIMS and treated as an environmental sample. The QA department reviews the results. The acceptance criteria for internally prepared containers are listed in Appendix D. All containers in lots not meeting the acceptance criteria must be reanalyzed or rewashed and another QC bottle processed. The process continues until criteria are met.

10.0 SHIPPING AND RECEIVING

Procedures to ensure the custody and integrity of the samples begin at the time of sample collection and continue through transport, receipt, storage, preparation, analysis, and disposal. Records concerning sample custody and condition are maintained in field and laboratory records.

10.1 Shipping

Upon request from the project manager, the shipping department packages the appropriate sample bottles into a shipping container (typically a Coleman® style cooler). In addition to bottles, sample labels, a Chain-of-Custody (COC) form, which includes a copy of our Sample Acceptance Policy and Terms and Conditions statement, and a return address label, are placed into the cooler. Additional cooler items may include, but are not limited to, temperature blanks, trip blanks (to accompany volatile samples when appropriate), icepacks, sampling instructions, and cooler custody seals.

10.2 Sample Receipt

A COC record, which documents the transfer of samples, must accompany all samples collected in the field or submitted to the laboratory for analysis. Since the initial entries are made at the time of sample collection only one form will be used for, both, field and laboratory custody.

The Sample Login Specialist or an assistant receives all samples into the laboratory. All sample containers are inspected and any bottle breakage or other abnormalities (such as insufficient sample volume or headspace in volatile bottles) are documented on the chain of custody record. Any discrepancies between the sample container identification and the chain of custody form are noted on the COC record. Client name, name and address of the contact person, name of sample collector, the sampler's telephone number/fax number/email address, sample description, time and date of sample collection, geographic state in which the sample was taken (for state-specific program requirements, when applicable), sample type, matrix, number of containers, requested analyses, and a relinquishing signature are required information of the COC. The chain of custody form is also used to document the receipt temperature of samples, as well as if the samples are received chilled, on ice, in proper containers and within the proper holding time(s). The Client Services Supervisor works with the Laboratory Supervisor and the Department Supervisors to set priorities based on client need and hold time.

The Cooler Receipt Form is used as required for samples applicable to the U. S. Army Corps of Engineers quality assurance program in conjunction with other laboratory documentation. This form may also be used for other clients (i.e. evidentiary samples) if requested.

The temperature measurement of a single representative sample container is required per cooler. The acceptance criteria for receipt temperature are 0.1 – 6^{o}C.

Samples that are hand delivered immediately following collection are considered acceptable if there is evidence that the chilling process has begun (e.g., ice or cooler packs are present). Chemical preservation is verified and documented at the laboratory bench prior to analysis. The sample control personnel sign the chain of custody form prior to sample information being logged into the LIMS. Copies of the Chain-of-Custody forms, Sample Acceptance Policy, and Cooler Receipt Form are in Appendix E.

The project manager must notify the client and resolve any anomaly/problem with a sample. Given the particular circumstance, the sample is not logged in until the problem has been resolved. The sample, however, will be maintained under proper thermal preservation. These discussions will be documented on a Non-conformance Form and can include, but are not limited to, the possibility of sample rejection, qualification of sample data, sample re-collection, or any other corrective action agreed upon by the client and the laboratory.

10.3 Login

All samples received at the laboratory are logged into a computerized laboratory information management system (LIMS) – Element®, which is used to assign a unique laboratory tracking number to each sample that will be retained throughout the life of that sample. The unique number is based on year, month, and sample delivery group as received sequentially in the laboratory. For example, login number 1031275-01A indicates, "1" is the year 2011, "03" is the month of March, and "1275" indicates that this particular sample group was the 1275th project logged in March 2011. Moreover, each container for a given sample is issued a unique container identification number. The numeral indicates the sample number and the alphanumeric letter represents a bottle for that sample. In the previous example, the letter "A" represents one bottle was received for sample "01" or it was the first bottle labeled.

Login personnel determine which analysis is required for a given sample from the information provided on the chain of custody and/or from information received from the appropriate project manager. The client information, received date and time, date and time of sample collection, due date, name of sample collector, sample description, matrix and requested analyses are logged into Element.

A summary of the sample log numbers assigned by Element™ is generated each day for the previous day. The purpose of this summary is to retain login information in the case of an Element™ failure. A "Login Receipts STL report" containing the information included in Element is generated for each sample. The sample COC, Login COC, and Sample Receipt Disclaimer are given to the applicable project manager who verifies the receipt of the sample, COC information, and analyses logged into Element™..

Element™ generates labels for each sample and container. These labels are durable, water resistant, and printed with indelible ink. The labels include information such as sample number, container identification, client name, sample description, matrix type, sampling date, due date, and bottle type. This container identification number is recorded on the laboratory raw data to provide a link between sample, analysis, and the container used.

Should any sample be sent to a subcontract laboratory, the login department will generate a new chain of custody for the sample(s) sent to subcontract laboratory. This chain of custody will identify the PDC Laboratories, Inc. - St. Louis sample number (Element™ number) so that client confidentiality is not compromised. However, if a sample is subcontacted for compliance analysis, additional information may be required as necessary (ie. NELAC accreditation). Subcontracted sample chain of custody forms will be returned to the client with the analytical results.

Typically, the samples submitted to PDC Laboratories, Inc. - St. Louis are for routine compliance monitoring. However, if a sample is submitted for the expressed purpose of litigation or if required by the project, sample and extract/digestate chain of custody within the laboratory will be documented at all times through the use of appropriate documentation.

10.4 <u>Sample Storage and Disposal</u>

Samples are stored in separate coolers by volatiles and non- or semivolatiles. Separate coolers are available to segregate program-specific samples from routine samples. Separate coolers are available for the storage of extracts and digestates. Food items are not allowed in the sample, standard, or reagent coolers.

All cooler temperatures are monitored and documented daily. All sample coolers are required to store samples in the range of 0.1 – 6°C. The acceptance criteria for freezers are -10º C to -20º C.

While in the laboratory, samples and their extracts/digestates are stored in limited access, temperature controlled areas. The analysts remove samples for analysis.

Element® generated lists indicate which samples must be retained and which samples may be removed from active cold storage. These removed samples are then transferred to an appropriate archiving area for further retention. Ultimately, the samples are removed from archives and disposed. Typically, removed wastewater samples are retained in cold storage for one week after report issuance and then disposed. Groundwater samples are retained until permission is given by the project manager to dispose. Archived solid samples remain on the shelves for four weeks. Samples may be retained for longer periods of time if agreed upon between the client and the project manager. Samples applicable to the U. S. Army Corps of Engineers quality assurance program and associated extracts/digestates are stored for a minimum of sixty days after the client receives the data report.

11.0 EQUIPMENT LIST AND MAINTENANCE

11.1 Major Equipment

A list of the major analytical equipment is included in Appendix F.

11.2 Routine Preventative Maintenance

To minimize downtime and interruption of laboratory operations, to prevent failure of equipment, and to ensure that the equipment is operating with the reliability needed for high quality data, preventative maintenance is performed on each instrument. This preventative maintenance includes, but is not limited to, instrument performance checks, calibration, cleaning, lubricating, reconditioning, adjusting, and documenting verifications. Trained internal staff aided by manufacturer's manuals and technical support or third party contractors perform repairs.

Each instrument operator is responsible for the detection of potential instrument problems and their successful resolution before using the instrument to generate data on samples. Maintenance logs are kept for each instrument near each instrument. These records document the identity of the instrument, the known history of the instrument (if applicable), the person performing the maintenance, and date the maintenance was performed. Examples of Preventative Maintenance Forms are included in Appendix F.

Instruments and equipment that are generating output that does not meet the required acceptance criteria must be labeled as "Out of Service". If applicable, the power supply to the equipment must be interrupted to prevent use.

11.3 Supply and Service Procurement

Department Supervisors are responsible for recommending, justifying, and obtaining the instrumentation and support supplies necessary for their department. Purchases must meet the needs of the laboratory accrediting authorities and/or be of adequate quality for the laboratory's application. In most cases, approved and/or recommended supplies are listed in the appropriate method's SOP. It is the responsibility of the Department Supervisors to obtain services and supplies that are of adequate quality. Generally, experience dictates those services and suppliers that are acceptable.

With the exception of reference standards (reagents, solutions, masses, and thermometers) and sample containers, all of which require a Certificate of Analysis, suppliers' quality control records are not required. The quality of reagents and other consumable supplies is verified through their use. The procedural quality control steps require that analyses indicative of positive or negative contamination must be repeated. Non-isolated failures must be corrected before sample analysis may continue. The quality control and corrective action records ensure the documentation of these efforts. Supplies that do not meet these criteria are no longer purchased.

An ongoing record, "Approval List", is maintained documenting the acceptability of supplies, suppliers, and service providers.

12.0 PROFICIENCY TESTING (PT)

Proficiency testing (PT) is defined as a means of evaluating a laboratory's performance under controlled conditions relative to a given set of criteria through analysis of unknown samples provided by an external source. The PT providers shall produce and distribute PT samples, evaluate study results against published performance criteria, and report the results to laboratories, the respective Primary Accrediting Authorities, the appropriate Proficiency Testing Oversight Body (PTOB)/Proficiency Test Provider Accreditor (PTPA), and NTI. The laboratory shall perform analyses of PT samples for each field of proficiency testing with the PT samples obtained from NELAP designated PTOB/PTPA-approved PT providers. The laboratory may obtain PT samples from any so approved PT provider. The results of the analyses shall be submitted to the PT provider for scoring. The goals of the PT program include the generation of data at a quality level required by environmental/regulatory programs, the generation of data, at a minimum, comparable in quality to that of other currently certified and/or accredited laboratories, and the improvement of the overall performance of laboratories over time.

Performance samples are used to evaluate the quality of the data produced by the analytical system. These samples are performed independently of and in addition to routine quality control checks. Performance samples are intended to reflect, as closely as possible, the laboratory performance under normal operating conditions. All performance samples are logged in as actual environmental samples and treated as such.

The laboratory will not send any PT sample to another laboratory or knowingly receive a PT sample from another laboratory for any analysis for which accreditation is sought or already accredited. Furthermore, the laboratory management or staff will not communicate with any individual at another laboratory or the PT provider in order to obtain the assigned value of the PT sample prior to general release.

12.1 Routine PT Samples

The laboratory participates in two single-blind, single-concentration PT studies, where available, per year for each field of proficiency testing for which it seeks to maintain accreditation. Two studies per year (five to seven months apart) are performed for the chemical analysis of each of the following matrices: wastewater, and RCRA solids/solid waste. PT samples for miscellaneous state or program-specific methods may also be analyzed as well as those for corrective actions as needed. Performance samples are also analyzed as required by the USEPA Discharge Monitoring Report – Quality Assurance (DMR-QA) program. Performance samples are analyzed for each microbiological approved technique on an annual basis. Water and solid matrix samples are analyzed in accordance with the requirements of the US Army Corps of Engineers Laboratory Validation Program as required. The laboratory's management and all analysts shall ensure that all PT samples are handled (i.e., managed, analyzed, and reported) in the same manner as real environmental samples utilizing the same staff and methods used for routine analysis of that analyte, procedures, equipment, facilities, and frequency of analysis. When analyzing a PT sample, the laboratory shall employ the same calibration, laboratory quality control and acceptance criteria, sequence of analytical steps, number of replicates and other procedures as used when analyzing routine samples. Supplementary or additional "known" third-party check samples should not be used unless part of a corrective action study.

Unless specified by the certification program, performance samples are obtained from a vendor approved by the National Voluntary Laboratory Accreditation Program. The laboratory authorizes the PT provider to release all results along with acceptable/not acceptable status directly to the TNI accrediting authority as well as to the laboratory.

Upon receipt of the PT report, the QA department evaluates the results and distributes copies of the report to the analytical Department Supervisors, Laboratory Supervisor, Client Services Supervisor, and the Laboratory Vice President. An "Acceptable" performance rating, as defined by the PT program, must be obtained. Results identified as “Not Acceptable”, as defined by the PT program, must be investigated and appropriate corrective action taken and documented. Water Pollution (WP) or equivalent studies include a third grading criterion for results – “Check for Error”. “Check for Error” results are between two and three standard deviations of the mean result submitted by all the participating laboratories in the study. The “Check for Error” grade is considered “Acceptable” but serves as a warning for possible further investigation.

The laboratory shall maintain copies of all written, printed, and electronic records, including but not limited to bench sheets, instrument printouts, data calculations, and data reports, resulting from the analysis of any PT sample for five years or for as long as required by the applicable regulatory program, whichever is greater. These records shall include a copy of the PT study report forms used by the laboratory to record PT results. All of these records are made available to the assessor during on-site audits of the laboratory.

12.2 Internal Proficiency Samples

Internal performance audits are usually conducted as part of the employee training and certification process, and as a follow-up to corrective action requests from unacceptable results on external performance testing samples. Typically, these are classified as double-blind samples since the analysts do not know their identity as performance samples nor do they know the true values.

PDC Laboratories Inc. coordinates and participates in a monthly quality control program for wastewater parameters. For this program, samples are prepared for a group of typical wastewater parameters. In addition to being entered into the LIMS as unknown environmental samples, samples are sent to participating laboratories for analysis as part of their on-going performance testing program.

13.0 CORRECTIVE ACTION

Corrective action is necessary whenever deficiencies from the quality system requirements occur. The laboratory quality system encourages the identification and resolution of quality anomalies by the employee responsible for performing the specific task.

Corrective actions are performed as needed and fall into one of two categories – method corrective action and system corrective action. Documentation of each type of corrective action is kept on file. The forms used are numbered and monitored by the QA department to ensure that out-of-control events and actions are documented and that the corrective actions are appropriate, effective, complete and verified as having been completed.

13.1 Method Corrective Action

Method Corrective action is performed on an as-needed basis and is usually initiated by an analyst, section supervisor, or department manager. This action may be initiated as a result of not meeting acceptance criteria for internal quality control checks including, but not limited to, poor recovery, precision, or instrument response. If, for example, the tuning criteria for a GC/MS analysis are not met, the analyst must stop and correct the deviation before any environmental samples are analyzed. Analysis can begin once the tune is properly verified. The department manager would typically become involved if a deviation were discovered after samples have been analyzed and data approved for reporting.

When analyses are performed using an unattended autosampler and the need for corrective action is not detected until after the analysis has been performed, the corrective action process must begin as soon as possible. In this case, samples that have been analyzed after the last acceptable quality control check must be reanalyzed.

Documentation describing the source of the problem and actions taken must be entered into the raw data, Corrective Action/Quality Improvement Report, or instrument maintenance log, whichever is appropriate. The Corrective Action/Quality Improvement Report documents client contact by the project manager, as well as providing information concerning the discrepancy or problem. A copy of the Corrective Action/Quality Improvement Report is included in Appendix G.

13.2 System Corrective Action

System corrective action is initiated at the request of the QA department. This type of action is usually initiated due to poor performance audit results, poor system audit results, or unacceptable results on performance testing samples.

Regardless of the source or it's projected impact on the system, the following systematic approach is used in developing a suitable corrective action. The emphasis of the corrective action is to prevent the problem from reoccurring.

- Define the problem
- Establish the root cause of the problem
- Determine the needed action to resolve the problem and eliminate the root cause
- Assign responsibility for implementing corrective action
- Verify the corrective action has been implemented and has eliminated the problem

A written request form is generated by the QA department and is forwarded to the appropriate department supervisor and copied to the Laboratory Supervisor. A copy of the Corrective Action Form is included in Appendix G. Either the department manager or the analyst assigned by the department manager is responsible for investigating the problem and determining the corrective action needed.

When the source of the problem has been identified and corrective action suggested, the form is completed, evaluated and, if appropriate, approved by the Department Supervisor, Laboratory Supervisor and QA department. At a time specified in the corrective action report, verification of the completeness of the corrective action is made by a member of the QA department. At that time, the corrective action is considered closed.

Although corrective actions are usually implemented after an out-of-control incident, occasionally, the need for a corrective action may be known in advance that would prompt a modification of a given procedure. The QAO, project manager, and/or laboratory supervisor must approve this deviation from a method or standard operating procedure in advance of deviating from a standard procedure. This exception can be documented by using the Quality Improvement Form. This type of exception or deviation from a procedure is more rare than a corrective action but may be warranted in limited cases.

13.3 Preventative Actions & Quality Improvements

Preventative actions or quality improvements should arise from a pro-active process or when non-conforming issues (technical, quality systems, or client complaints) occur.

The issues involving preventative actions/quality improvements are an integral part of scheduled management meetings. However all employees are encouraged to submit issues as part of the process.

PDC Laboratories, Inc. – St. Louis has combined Corrective Actions with the concept of Preventative Actions & Quality Improvements. The combined report is referred to as the Corrective Action/Quality Improvement Report (CA/QIR). The QIR and associated tracking system will be used to document the nature of the problem, recommend solutions, and monitor actions taken. Alternatively, internal and sample audit findings and observations may be documented in a report format and must be included in the tracking system. Scheduled management meetings will be used to review progress and implementation of issued CA/QIRs.

14.0 DEVIATION FROM POLICY OR PROCEDURE

PDC Laboratories Inc.'s quality assurance program is designed to meet the requirements of various certification programs, environmental compliance programs, and analytical testing requirements. On occasion, situations present themselves where the "standard" requirements cannot be obtained, maintained, or simply are not applicable. In cases such as these, deviation from written policy or procedure may be acceptable. Each case needs to be considered on its own merit. The analyst is responsible for discussing alternative options with the department manager, project manager, or quality assurance department.

Data qualifier flags shall be used, where applicable, on the analytical reports to indicate a quality control deviation or to disseminate performance data to clients. It is the responsibility of the analyst to add these flags into the LIMS at the time of data entry. A list of available flags is presented in Appendix H. When a qualifier is used, it is defined on the last page of the analytical report.

15.0 COMPLAINTS

A complaint is a client's formal expression of dissatisfaction with the performance of one or more of the laboratory's activities. The complaint may originate internally or externally to the laboratory. Examples of complaints may include bottle shipment errors, calculation errors, data that does not make sense, incorrect analyses performed, typographical errors, accidentally omitted results or late reports. Upon receiving a complaint, the complaint will be documented on a Client Complaint Record (short form) or a Client Complaint Resolution Record, depending on the severity of the complaint. The Client Services Supervisor will assign a client services representative to resolve the complaint and complete the proper form. The complaint will be considered resolved when the following conditions are met: (a) all the facts have been gathered from the client or party who initiated the complaint, the project files, the project manager, and the employee(s) most directly involved, (b) a decision has been reached and corrective action, proposed, if necessary, to correct any problems, (c) the client has been informed as to the corrective action/resolution, and agreement to the response by the client is documented, (d) corrective action taken and (e) all forms documenting these steps have been completed, signed by the appropriate director and filed with the Director of Quality Assurance. Specific procedural details may be found in the SOP, CLIENT COMPLAINT RESOLUTION.

16.0 CONFIDENTIALITY

All reports and related information provided to and paid for by clients of PDC Laboratories, Inc. - St. Louis in connection with PDC Laboratories, Inc. - St. Louis are the property of the client. The term “Confidential Information” means information concerning PDC, which is not generally known to those, engaged in similar businesses (realm of public domain) and that is used or obtained by PDC in connection with its business. Specifics concerning the term “information” and other procedural details may be found in the SOP, GEN-ClientConfident.

No such property will be provided to any other party, by any means (verbal, written, or electronically) or discussed with another party without the expressed consent of the client. PDC Laboratories, Inc. - St. Louis reserves the right to request written authorization to release information.

No employee shall release, or cause or allow the release of, information to the communications media, except as required by law, concerning the existence or terms of services, including the identification of the client, the samples, or the general description, characteristics, or constituents of the samples, without, in each case, securing the prior consent of the client. Actions contrary to this will result in disciplinary action with possible termination. It is PDC Laboratories, Inc. - St. Louis’s policy to fully comply with any court issued subpoenas for information. Such requests are to be brought to the attention of the Laboratory Vice President for referral/consultation with the company legal representative prior to the release of the information.

When providing information to clients from internal sources that contain other client’s information, the identity of the other clients must be withheld. This practice includes preparing QC Summaries, data packages, and any other raw data. To avoid the inadvertent release of confidential Information, the Quality Assurance Officer or designee should review the information prior to submittal to the client.

In the event of an inadvertent release of information (wrong address on envelope, switched envelopes, incorrect email address, etc.) every effort should be made to have the original information returned to PDC Laboratories, Inc. - St. Louis. Any inadvertent release of confidential information will be investigated.

Electronic transfer of data or any project related information from PDC Laboratories, Inc. - St. Louis via facsimile (fax) or electronic mail systems (e-mail) must be accompanied by the following statement:

> **“This communication including any attachments is for the exclusive and confidential use of the designated recipient, and any other distribution or use is unauthorized and strictly prohibited. If you have received this communication in error, please notify the sender by replying to the message and then deleting the message from your system.”**

If so notified, the appropriate laboratory representative will decide the further action to be taken.

Disregard of these procedures will result in disciplinary action which may include any or all of the following: verbal warning, written warning, unsatisfactory performance review, salary reduction considerations, termination, or potential legal actions brought in a court of law by outside parties.

17.0 INTERNAL AUDITS

The STL-SOP-GEN IntAudit details the steps taken to perform internal audits of the laboratory quality system, laboratory data, and analytical procedures. The quality systems audit identifies the presence of the necessary organization, facility, and quality systems (i.e. purchasing and corrective actions) needed to provide evidence of the laboratory's capability and competence. Performance audits are used to evaluate the quality of data by the analytical system. Regardless of the type of audit performed, the results of the audit are documented using a set of standardized audit forms. Using the appropriate checklist, a representative of the QA department reviews the actions of the laboratory. The checklists are based on the current adopted TNI standards and are updated as the standards change. Audit finding that cast doubt on the correctness or validity of sample results must be investigated. If the investigation shows the laboratory result(s) have been negatively affected and the clients' requirements have not been met. The client must be notified in writing within three working days of the conclusion of the investigation and formulation of an appropriate corrective action. All investigations that result in findings of inappropriate activity are documented and include any disciplinary actions involved, corrective actions taken, and all appropriate notifications of clients.

A copy of the completed individual performance audits and individual sections of the quality system shall be forwarded to the analyst, appropriate Department Supervisor and Laboratory Supervisor. The original audit will be filed in the QA office. The Quality Assurance Officer prepares preliminary reports of partial audit findings, including a general statement on the overall compliance. Examples of items in compliance as well as all non-compliant findings shall be detailed. Target dates for corrective actions are included for each deficiency. A follow-up audit of the deficiencies will be performed. The follow-up shall be performed after a target date for correction has been established. A copy of the follow-up will be forwarded to the Vice President, Laboratory Supervisor, and applicable Department Supervisors/Directors when complete. The original follow-up notice shall be filed in the QA office along with the original audit report.

A comprehensive final report of both the Quality Systems Audit and Performance Audits will be forwarded to the Vice President, Laboratory Supervisor, and applicable Department Supervisors/Directors by the end of December. The original report will be filed in the office of the Quality Assurance Officer.

18.0 TRAINING

All personnel are appropriately trained and competent in their assigned tasks before they contribute to functions that can affect data quality. It is management's responsibility to assure personnel are trained. Training records are used to document management's approval of personnel competency

Training records are maintained by the analyst in a training manual which includes SOP review, source method review, and initial demonstration of capability and by management which includes MDL studies, initial and ongoing demonstration of capability studies and the results of PT samples.

A separate file kept by the QA Department contains proof of education (diploma/transcripts) and a signed Ethics and Data Integrity Agreement,

18.1 Training of New Staff

New staff members are given the following general laboratory orientation upon arrival:

1. Welcome – Orientation Overview and Agenda,
2. New Employee Payroll Documentation,
3. Anti-Harassment Acknowledgement,
4. Drug Free Workplace Acknowledgement,
5. Family Medical Leave Act Acknowledgement
6. New Employee Network Sign on and Request Form,
7. Clock In/Out and Uniform Forms, and
8. "Brief Lab Tour" – Restrooms and Break Room.

Additional "new employee" topics covered include:

1. Employee Identification Register (signs printed and script name with initials)

2. Ethics & Data Integrity Agreement (sign-off),
3. EEO/Veterans/Disability Form (fill-out)
4. Funeral Leave Policy/Absence-Illness Policy,
5. Jury Duty Policy,
6. Paid Time Off Policy,
7. Electronic Communications Policy/Laboratory – New User Sign on Request,
8. Recycling Program,
9. Contact the Health and Safety Officer (HSO) to schedule company physical (if applicable),
10. Computer/Internet Use Policy,
11. Computer User Logon Request,
12. Quality Assurance Program – Overview,
13. Quality Assurance Plan (sign-off),
14. Confidentiality, and
15. Copy of applicant's resume and diploma/transcripts.

The new employee orientation is documented on the Employee Orientation Checklist that outlines what was covered during the training.

18.2 Initial Training

The initial training for a new task contains the following steps:

1. All documentation involved with a new and unfamiliar task is read and understood by the trainee, including but not limited to SOP and source method documents.
2. Training is under direct supervision of a certified senior analyst. During the time the analyst is in training, the trainee may sign laboratory notebooks, logbooks, worksheets, etc. but they must be supervised in the testing performed.
3. The trainee must demonstrate competency in new tasks before they can perform independently, i.e., with a certified analyst not present at the time of testing. An Initial Demonstration of Capability (IDC)

must be performed to prove competency. This competency is documented through IDC Certification Statement (see Appendix I). Approval of competency is noted by the date and signature of the trainer.

4. Each step of the training process is documented. Records of certification are maintained in the analyst's training manual.

18.3 Ongoing Training

1. The employee attests, through signature, that they have read, understood, and agree to comply with the latest version of the Quality Assurance Manual and any SOPs or policies that the employee is responsible for following.
2. At least annually, the analyst demonstrates ongoing capability in each method they perform.
3. The employee attends in-house training relating to job function as applicable.
4. The employee participates in vendor training and workshops.
5. The employee attends refresher data integrity training.
6. The analyst attends health and safety training as required.
7. The staff member gains familiarization with administrative and personnel policies and procedures by HR or designate.

All training must be documented in the employee's training manual.

18.4 Training Overview

The analytical department supervisor oversees the department orientation and SOP/method training received by each new employee. Analytical skills are learned during on-the-job training with appropriate supervision. After competency has been gained in a particular area or with regard to a specific SOP, the new analyst substantiates his/her skill (and as part of a work cell) via an Initial Demonstration of Capability (IDC)*. A set of "blind" PT samples may also be analyzed. Each step of the analytical training is verified and documented by the department supervisor or designee. All supporting documentation must be retained. Each time there is a change in instrument type, test method, or personnel the IDC must be repeated. Once per year the analyst (and work cell) shall demonstrate performance through the use of LCS samples or PT studies.

All positions directly or indirectly affecting the quality of the data, data reports, or other customer products or services must be directly supervised during the initial orientation and training period. This period will meet the minimum requirements above, when applicable, and can vary depending upon the nature of the position and the qualifications of the employee in that position. All analytical data generated by an employee in training shall be reviewed by the trainer, department supervisor, or a representative of the QA department prior to approval in the LIMS and documented.

* When it is not possible to determine mean / standard deviations, such as for presence/absence and log values, PDC Laboratories, Inc. – St. Louis will assess performance against established and documented criteria.

18.5 Department Responsibilities

The department supervisor is responsible for assigning a trainer to instruct the individual for each specific procedure he/she performs. The trainer's responsibility is to train the individual to the procedure and to be an information resource for the trainee. The department supervisor is also responsible for measuring the performance proficiency of the trainee. This measurement can involve the analysis of a set of PT samples, a written or oral examination or direct observation.

19.0 ETHICS

Although each employee has a unique set of individual moral values, organization ethics at PDC Laboratories, Inc. begins with a set of shared, moral values based on certain fundamental principles. Any trust and cooperation within an organization must be based on integrity, honesty, loyalty, and prudence.

All employees of PDC Laboratories, Inc. - St. Louis are expected to conduct themselves and the business of PDC Laboratories, Inc. in a professional and ethical manner. The success of this Quality Assurance Plan is based on the shared ethical behavior of all employees. Ethical behavior is defined as actions performed that exhibit "right" or good conduct. Actions not in accord with this definition usually attempt to "short cut" or avoid a potential problem. It must be realized that these short-term compromises are not worth the long-term consequences. All actions and decisions must have the highest regard for the intention as well as the letter of the requirement. PDC Laboratories, Inc. is always willing to accept the rigors of doing what is right, thereby creating an atmosphere free from any commercial, financial, and other pressures, which might adversely influence the quality of our service.

Compliance with this policy is required and will be strictly enforced. Each employee must at the time of employment and annually thereafter sign the "Ethics and Data Integrity Agreement". The following are examples of unethical behavior. This list is not all-inclusive and the examples are not ranked in any particular order.

Examples of Unethical Actions

- Misrepresentation of credentials, including education, training, employment history, etc.
- Forging another person's name or initials.
- Intentional falsification of time sheets.
- Not following the approved SOP.
- Falsifying analytical data (i.e. "dry labbing") or any other sampling and analysis data. Examples of this are, reporting a result without actually performing the procedure, or

assigning a date/time of sample collection without knowledge of the actual collection information.

- Knowingly altering data entries without acceptable justification.
- Improper calibration or verification. Examples of this are, not performing the required calibration, not performing the calibration properly, improper tuning of the GC/MS, or not performing the required continuing verification quality control.
- Not preparing or analyzing method blanks and laboratory control samples (LCSs) the same way that samples are prepared or analyzed in order to make it appear that the method blank or LCS results are acceptable when, in fact, they are not.
- Misrepresentation of analytical data. Examples of this are, using a sample size or final volume in the calculation when a different sample size or final volume was actually used in the analysis, or over-dilution or under-dilution of samples or standards. This also extends to the falsification of standards or reagent preparation data.
- Improper peak integration (i.e. peak shaving or peak enhancing).
- Misrepresentation of the nature of a sample. This is using a sample (QC or real world) as if it were digested/extracted when it actually was not.
- Improper alteration of the analytical conditions. Examples of this are, improperly changing settings (oven temperature, flow rate, injection volume, etc.) to assist in recovery.
- Improper clock setting on a computer.
- Intentional deletion of noncompliant data.
- Intentional omission of a required data flag(s).
- Raw data file substitution. This action includes the renaming of a file for use in another data set or as another sample in the same data set.
- Unwarranted manipulation of computer software.
- Intentional misrepresentation of reported data. This includes the date/time of analysis, method performed, analyst, etc.
- Signing for review of data when such review was not completed.

Disregard of these procedures will result in disciplinary action which may include any or all of the following: verbal warning, written warning, unsatisfactory performance review, salary reduction considerations, termination, or potential legal actions brought in a court of law by outside parties.

20.0 DATA REDUCTION, VALIDATION AND REPORTING

PDC Laboratories, Inc. - St. Louis utilizes the Promium Element Datasystem® LIMS Version 6.09:2010 and updates. The LIMS database is SQL Server2008 and resides on a discreet Windows 2008 Server. The analytical data generated by PDC Laboratories, Inc. - St. Louis is recorded at the bench, reviewed, transferred into and managed within the LIMS, reported to the client and ultimately, archived.

20.1 Computer Database Management

The overall goal in the utilization of computerized and automated data acquisition equipment is to maintain a secure operating environment. System integrity is maintained by three principle elements including password encryption, hardware isolation, and data backups. Each of these elements is designed to guard against data loss caused by human error, system crashes, or hardware failure. The Database Administrator maintains a complete list of all installed software and the original installation media in a secure area.

Data integrity is maintained as a function of password encryption and limited access to data acquisition software. All users are identified by a unique username and password assigned by the system administrator. The structure of a login allows that each user be granted selected rights to directories, files, and resources which are pertinent to their assigned job. Superuser, Admin, and Supervisor authority rights are restricted to two individuals within the laboratory. In the event of an emergency, the current password list is available from the Database Administrator.

Electronic hardware isolation is obtained through the combination of fiber optics, dedicated power circuitry, and an uninterruptable power supply (UPS). The SQL Server data files are distributed over different RAID5 disk arrays to avoid loss of data due to failure of a single drive. The physical location of the server hardware was selected to control ambient environmental conditions.

Data backups are routinely performed to ensure that data integrity is maintained and data is recoverable. The first type of data backup is performed on the local area network (LAN). A series of digital audiotapes (DAT) are rotated weekly with a full system backup performed.

The LIMS software resides on a Dell PowerEdge R710 Server. DLT backups via DAT tapes are performed incrementally throughout the week and a complete automated system backup is performed each Friday. The files on the DLT tape system represent user and operating system files necessary to maintain the system. A full database export is performed Monday through Friday, when the export files and the actual data files are copied to tape. This tape is then taken off site to another PDC building the following morning. The database is also run in archive log mode. Each transaction is written out to log files which can be read back in when a database recovery is necessary. This will allow recovery of transactions happening after the last tape backup.

20.2 Data Reduction

Data reduction is the process of converting raw data into final results that are reported to the client in a standard format. For example, data reduction involves the handling of raw sample data including, but not limited to, detector response, titrant volumes, dilution factors, sample size and gravimetric measurements to achieve final sample analyte concentrations. PDC Laboratories, Inc. - St. Louis automates data calculation and reduction as much as possible through the use of computers, various software packages, and the laboratory information management system (LIMS).

20.3 Manual Integration

Manual integration may be performed to accurately calculate the concentration of a compound in a gas or liquid chromatography method when, in the analyst's professional opinion, the automated measurement is not properly performed. Efforts have been made during method development to include the best instrument parameters that allow for automatic integration by the data system in most cases.

However, regardless of the sophistication of the software, instances occur when the automated software does not integrate a peak correctly. The failure of the software to appropriately integrate a peak is usually obvious from visual inspection of the chromatogram (at an appropriate scale). Various errors occur which include, but are not limited to, peak splitting, adding area due to a co eluting interferant, failure to detect a peak, excessive peak tailing due to failure of the instrument response to return to baseline or a rise in the baseline, and failure to separate peaks. Instrument software packages generally provide a procedure where by the analyst can review the individual data file and provide peak specific instructions on integration to correct these problems. This procedure is referred to as "manual integration" and relies solely upon the experience of the analyst to determine proper integration for each peak. The SOP, CHROMATOGRAPHIC PEAK INTEGRATION PROCEDURES, defines appropriate chromatographic peak integration and provides the procedures for completing and documenting corrections to analytical results.

20.4 Data Review

Before entering sample data into the LIMS, data are evaluated by the analyst, a peer, or the section supervisor. The data are evaluated in terms of client-specific data quality objectives, program-specific objectives or to the "standard" NELAC requirements. The analyst must adhere to the calibration and quality control requirements detailed in the appropriate SOP. Any data that does not meet these requirements are appropriately flagged with a qualifier and an explanation is included with the final report issued to the client by the project manager. A minimum of a two-tier review is performed prior to report submittal to the client.

20.4.1 Analyst Review

The analyst conducts the first level of review and is responsible for assuring that the analysis was performed correctly and was accurately transferred into the LIMS. Standardized QC Checklist forms are used to document the review of elements such as reporting limits, calculations, quality control sample recoveries, holding times, etc. Copies of these forms are in Appendix J. Upon entry or upload of data into Element, the Data Entry/Review page will display the data with one of the following colors. The analyst must make any necessary corrections based upon these qualifiers.

Red -	QC failure, holding time violation or sample/prep/analyzed dates out of order.
Purple -	Result that was red-shaded has been qualified.
Orange -	Result exceeds a flag that has been set for the analyte {Exceedance}.
Magneta -	Results have values between the analyte detection limit, MDL, and the reporting limit, MRL. {CLP – J}
Blue -	Result values over the analyte reporting limit. {MRL}
Green -	Either the FMDL (Final MDL) or FMRL (Final MRL) will be green-shaded indicating to which the results will be reported out.
Dark Red -	FMRL exceeds one or more Flag levels.
Light Orange -	QC limits are customized at the project.

It is the responsibility of the analyst to correctly increase or confirm the increase of the reporting limit when a smaller than required sample size is used, and to assess the need for data qualifiers and enter the appropriate data qualifiers into the LIMS. The completion of this review is recorded in LIMS by changing the status to “Reviewed”. ***QC Checklists are not used for microbiology analyses.***

20.4.2 <u>Section Supervisor Review</u>

Only client-specific or program-specific projects require this review step. After the ‘Reviewed’ status is complete the section supervisor is given the opportunity to perform the administrative review. The section supervisor will periodically review data from their department. The review is structured so that all calibration data and quality control sample results are reviewed, and the analytical results are verified back to the raw data forms. This step is complete after the section supervisor signs and dates the review documentation. When complete, data from this review is given to the project manager for report generation and appropriate data storage.

20.4.3 Project management (Administrative) Review

Before the data is released to the client, a project manager will review all final reports for consistency and completeness to ensure that the data meet the overall data quality objectives of the client and the project. This review is intended to verify that those analyses requested on the chain of custody have been performed, the sample information is accurate, appropriate data qualifiers have been added, the data is consistent with expected norms (e.g. BOD vs COD, influent vs effluent results, etc.), and is consistent with historical data from that sampling point. All discussions with analysts, clients, or subcontract labs will be documented through copies of emails that will be attached to the data package. The project manager has the authority halt or withhold data or test reports until concerns are resolved. This last element is referred to as a check of “reasonableness”. This step is complete after the reviewer performs the appropriate status update in the LIMS.

Subcontracted data is reviewed by the project manager prior to issuance to the client. This review is to verify that the data quality objectives are met for this subcontracted analysis. Subcontracted analyses must be performed with the consent of the client, and performed by laboratories approved by the client and PDC Laboratories, Inc.

20.4.4 Quality Assurance Review

In addition to the tiered review process, the Quality Assurance Department will periodically audit analytical data. These audits are required as part of our quality systems audit program, are performed for the generation of reports that include quality control data, and as a troubleshooting measure. Batches that are reviewed are chosen on a random basis. These reviews are performed monthly to verify compliance with the requirements of this quality assurance plan and the appropriate SOPs.

20.5 Data Transfer

Analytical results for each sample are entered into the LIMS. These results may be entered either manually or by electronic data transfer (EDT). Where available, EDT should be used. Data is entered after the appropriate data reduction and data review has been performed. As the LIMS automatically performs EPA compliant rounding, data should be entered without manual rounding of results. The LIMS also performs a variety of automatic calculations such as hold time evaluation, dry weight determination, percent recovery on quality control samples, and conversion of results to other units.

20.6 Reporting

The reporting of client information can be provided in a wide variety of different formats. The following sections describe these options

20.6.1 Routine Reports

Multiple report levels are available to meet the needs of our clients.

The standard report format is “sample results only”. This standard analytical report contains the following:

- Laboratory name, address, and phone number
- Client name and address
- Date and time of sample collection
- Date sample(s) was received
- Date of report
- Purchase order number reference (if required/provided)
- PDC Laboratories, Inc. - St. Louis customer number

- Internal login number
- Statement of applicability
- Total number of report pages and individually numbered pages
- Sample number(s)
- Client sample identification(s)
- Analysis performed
- Signature block for release of the report
- List of laboratory accreditation’s/approvals
- Analytical method reference
- Analyte
- Applicable data qualifiers
- Result (at client requested reporting limits and units)
- Units
- Date and time of analysis
- Analyst initials

The original chain of custody form is returned with each report. Any deviations from the requirements of our Sample Acceptance Policy will be noted on the final report.

If any material amendments are made to a report after issuance the new report must be identified as ‘Supplemental to…’ or ‘Revised’ and must conform to the requirements of this section.

When subcontractors perform testing, the report results should be received in writing. Subcontractor’s name or applicable accreditation number must appear with all test results. Copies of this report will be available to the client upon request.

20.6.2 Project or Client-Specific Reports

Report formats beyond the standard NELAC compliant results–only format are project or client specific and may include various combinations of the following:

- QC Summary Report – summary of the method required QC elements (such as method blank, laboratory control sample, matrix spike, matrix spike duplicate, calibration checks and surrogates)
- Case Narrative – narrative report of QC elements and description of any exceptions
- Raw Data – copies of all laboratory bench sheets, computer print-outs, run logs, standard logs, etc. used in the generation of the specific analytical result

Other hard copy report formats can be delivered upon request. These include, but are not limited to, state specific compliance reports, program specific compliance reports, and user specified custom reports. Our standard hard copy report must be delivered in addition to any alternate format requested.

Appendix A - Personnel, Education, Function & Experience

NAME	EDUCATION	FUNCTION	DEPARTMENT	YEARS EXPERIENCE (update Jan 2013)
John LaPayne*	B. S. Chemistry / Biology	Vice President	**Administration**	**34**
Keith Earhart	A.A.S. Electronics Chemistry / Biology	Laboratory Supervisor	**Administration**	**34**
Wayne Cooper	B.S. Chemistry / Biology	Quality Assurance Officer	**Administration**	**37**
Mark Schrader	B.A. Chemistry & M.B.A	Technical Sales Representative	**Administration**	**24**
David Elliott*	A.A.S Psychology	Laboratory System Administrator	**Administration**	**6**
Jim Kitchen	B.S. Sec Educ (Biology)	Organics Supervisor	**Organic Chemistry**	**24**
William Stork	B.S. Zoology	Inorganics Supervisor	**Inorganic Chemistry**	**29**
Roxann Shull	High School	Client Services Supervisor	**Support Services**	**21**
Larry Oliver	Ph.D. Nuclear Chemistry	Director of Field Services	**Field Sampling**	**12**
Barbara Earhart	A.A.S. Computer Science	Office Manager	**Administration**	**11**
Heather Earhart	2 Yr. College	Login Specialist	**Support Services**	**8**
Barb Pandolfo	B.S. Biology / Chemistry	Project Manager	**Administration**	**37**
Bryon Prokopf	B.S. Chemistry	Analyst	**Organic Chemistry**	**7**
Mary Piker	High School	Technician	**Organic Chemistry**	**24**
Felicia Mollison	High School	Technician	**Organic Chemistry**	**24**
Claude Vitatoe	B.A. Psychology	Analyst	**Inorganic Chemistry**	**44**
Dave Myers	1 yr. College	Analyst	**Inorganic Chemistry**	**23**
Julie Strathman	High School	Analyst	**Trace Metals**	**34**
Rich Koenig	A.A.S. Chemical Technology	Field Technician	**Field Sampling**	**36**
Dave Althage	B.A. Secondary Education	Courier / Field Technician	**Field Sampling**	**3**
David Whitley	B.S. Chemistry	Analyst	**Inorganic Chemistry**	**<1**

* based in Peoria

Appendix B - Definitions & Acronyms

Acceptance Criteria – specified limits placed on characteristics of an item, process, or service defined in requirement documents

Accuracy – the degree of agreement between a measured or observed value and an accepted reference value of the quantity of concern

Aliquot – a measured portion of a sample, or solution, taken for sample preparation or analysis

Analyte – the specific component measured in a chemical analysis

Audit – a systematic evaluation to determine the conformance to quantitative and qualitative specifications of some operational function or activity

Batch – environmental samples that are prepared and/or analyzed together with the same process and personnel, using the same lot(s) of reagents. A **preparation batch** is composed of one to 20 environmental samples of the same matrix, meeting the above mentioned criteria and with a maximum time between the start of processing of the first and last sample in the batch to be 24 hours. An **analytical batch** is composed of prepared environmental samples (extracts, digestates or concentrates) which are analyzed together as a group. An analytical batch can include prepared samples originating from various environmental matrices and can exceed 20 samples. Typically, these are samples in the same workgroup (WG) in the analytical department of the LIMS (Element).

Blank – an artificial sample designed to assess contamination during sampling, transport, storage or analysis. The blank is subjected to the usual analytical and measurement process to establish a zero baseline or background value. Blanks include:

- Calibration Blank – an aliquot of the standard diluent (water or organic solvent) that is not carried through the sample preparation scheme. It is analyzed to verify that the analytical system is free from contamination. Also referred to as an instrument blank.
- Equipment Blank – a sample of analyte-free media which has been used to rinse common sampling equipment to check the effectiveness of decontamination procedures

- Field Blank – blanks that are prepared in the field by filling a clean container with pure de-ionized water and appropriate preservative, if any, for the specific sampling activity being undertaken and analyzed to determine the level of contamination introduced into the sample due to sampling technique and environmental factors.
- Method Blank – an aliquot of laboratory pure water or solid matrix taken through sample preparation (when required) and analysis. It is a test for contamination in sample preparation and analyses. Also referred to as a Procedural Blank.
- Trip Blank – an aliquot of laboratory pure water that accompanies the sample containers to the sampling site and returns to the laboratory. Used for volatile samples. The holding time for a trip blank begins when samples are collected. Trip blanks do not need to be analyzed if VOC, GRO, and/or PVOC compounds are not detected in any of the associated water samples.
- Storage Blank – an aliquot of laboratory pure water stored and analyzed with samples at the laboratory. It is a test for contamination in sample storage.

Blank Spike (BS) – an aliquot of laboratory pure reagent spiked with target analytes or compounds representative of target analytes. The sample is carried through the entire analytical process and analyte recovery is used to monitor method performance.

Blind Sample – a sample, known by the submitter, that is submitted in such a way that the analyst does not know its composition. It is used to test the analyst's or laboratory's proficiency in the execution of the measurement process.

Bias – the deviation of a measured value from a known or accepted value due to matrix effects or method performance. Bias may be determined quantitatively to correct measured values. Bias may be positive or negative.

Breakdown – a measure of the decomposition of certain analytes (DDT and Endrin) into by-products.

Calibration – a set of operations that establish an analytical curve based on the absorbance, response, emission intensity, or other measured characteristic of known standards. The calibration standards must be prepared using the same type and concentration of acids, solvents, or other solutions used in the sample preparation.

Calibration Curve – the graphical relationship between the known values, such as concentrations, of a series of calibration standards and their instrument response

Calibration Factor – a measure of the gas chromatographic response of a target analyte to the mass injected. The calibration factor is analogous to the Relative Response Factor (RRF) used in gas chromatograph/mass spectrometer (GC/MS) volatile and semi-volatile fraction analyses.

Chain-of-Custody – procedures and associated documents designed to trace the custody of a sample(s) from the time of collection to final disposition, with the intent of legally demonstrating that custody remained intact and that tampering or substitutions were precluded. The record generally includes: the number and types of containers; the mode of collection; collector; time of collection; preservation; and requested analyses.

Check Standard – a standard of known value used to verify titrant strength and/or used to determine that the method is in control when a laboratory control sample or calibration curve is not used.

Completeness – the percentage of measurements made which are judged to be valid measurements. The completeness goal is to generate sufficient amount of valid data based on project needs.

Confirmation – verification of the identity of a component through the use of an approach with a different scientific principle from the original method. These may include, but are not limited to: second column confirmation, alternative wavelength, derivatization, mass spectral interpretation, alternative detectors, or additional cleanup procedures.

Continuing Calibration Verification Standard (CCV) – a standard used to verify the continued acceptability of the initial calibration curve. A continuing calibration verification must be repeated at the beginning and end of each analytical batch and every 10-20 samples, whichever is more frequent depending on the method requirements. The concentrations of the continuing calibration verification standard shall be varied within the established calibration range. If an internal standard is used, only one continuing calibration verification must be analyzed per analytical batch.

Control Limit – the limits shown on a control chart beyond which it is highly improbable that a point could lie while the system remains in a state of statistical control.

Control Chart – a graphical plot of test results with respect to time or sequence of measurements together with limits within which they are expected to lie when the system is in a state of statistical control.

Corrective Action – the action taken to eliminate the causes of an existing nonconformity, defect or other undesirable situation in order to prevent reoccurrence

Data Audit – a qualitative and quantitative evaluation of the documentation and procedures associated with environmental measurements to verify that the resulting data are of acceptable quality (i.e., that they meet specified criteria)

Data Quality Objectives (DQOs) – during the planning phase of a project requiring laboratory support, the data user must establish the quality of data required from the investigation. Such statements of data quality are known as DQOs. DQOs are qualitative and quantitative statements of the data required to support specific decisions or regulatory actions. DQOs must take into account sampling considerations as well as analytical protocols.

Demonstration of Capability – a procedure to establish the ability of the analyst to generate acceptable accuracy

Detection Limit – the lowest concentration or amount of the target analyte that can be identified, measured, and reported with confidence that the analyte concentration is not a false positive value

- CRDL – Contract Required Detection Limit
- IDL – Instrument Detection Limit. A statistically determined detection limit used to estimate the instrument's sensitivity. The IDL is obtained by analyzing seven consecutive standards, without preparation, at a concentration of 3 – 5 times the estimated IDL. These standards must meet criteria of bias and precision.
- MDL – Method Detection Limit. The minimum concentration of a substance that can be measured and reported with a 99% degree of confidence. MDLs are

determined by analyzing a minimum of seven consecutive standards that have been processed through all preparatory steps. These standards must meet criteria of bias and precision.

- PQL – The Practical Quantitation Limit is the lowest concentration that can reliably be achieved within specified limits of precision and accuracy during routine laboratory operating conditions. Typically, the PQL is a value in the range of 5 – 10 times the MDL. Also referred to as the Estimated Quantitation Limit (EQL).
- RDL – The reportable detection limit is the lowest concentration that can be reliably reported within specified limits of precision during routine laboratory operating conditions. Typically, the RDL is a value near 2.2 times the MDL, or is the concentration of the lowest calibration standard. Whenever possible, concentrations will not be reported down to the MDL. Also referred to as the Reporting Limit (RL).

Document Control – the act of ensuring that documents (and revisions thereto) are proposed, reviewed for accuracy, approved for release by authorized personnel, distributed properly and controlled to ensure use of the correct version at the location where the prescribed activity is performed.

Estimation of Measurement Uncertainty – is a procedure for estimating the uncertainty of an analytical measurement. Reference: SOP-GEN-EstMeasUncert.

Grubb's Outlier Test – a statistical test useful for making decisions on the rejection of outliers. Reference: Taylor, John Keenan. Quality Assurance of Chemical Measurements. Lewis Publishers, 1987. 36

Headspace – any area in a container not completely filled by the sample, thus allowing gases to collect in that space.

Holding Time – the maximum storage time for samples allowed between sample collection and sample analysis when the designated preservation and storage techniques are employed and still be considered valid or not compromised

Initial Calibration Verification (ICV) – a standard used to verify the accuracy of calibration standards. Prepared from a second source than that of the calibration standards, its known value is measured against the calibration curve determining the integrity of the working standards. Also referred to as an external verification standard or check standard.

Internal Standard (ISTD) – analyte(s), not of interest as a target analyte, which is added to all samples, QC samples, and calibration standards just prior to instrumental analysis. Internal standards are used as the basis for quantitation of target analytes for GC, GC/MS and ICP/MS analyses.

Laboratory Control Sample (LCS) – an aliquot of laboratory pure reagent spiked with target analytes or compounds representative of target analytes. The sample is carried through the entire analytical process and analyte recovery is used to monitor method performance.

Laboratory Control Sample Duplicate (LCSD) – an aliquot of laboratory pure reagent spiked with the identical amount(s) of target analyte(s) as the LCS. Results of the two spikes are used to assess both the bias and precision of a method with a given sample matrix.

Laboratory Duplicate – aliquots of a sample taken from the same container under laboratory conditions and processed and analyzed independently

Limit of Detection (LOD) – an estimate of the minimum amount of a substance that an analytical process can reliably detect. An LOD is analyte-and-matrix-specific and may be laboratory-dependent

Limit of Quantitation (LOQ) – the minimum levels, concentrations, or quantities of a target analyte that can be reported with a specified degree of confidence

Matrix – the component or substrate which may contain the analyte of interest. Matrices are limited to the following: aqueous (includes extracts from the TCLP or other extraction procedure, groundwater, surface water, and wastewater), drinking water (potable water and laboratory pure water), non-aqueous liquid (organic liquid having <15% settleable solids), and solid (includes sediment, sludge, and soil).

Matrix Interference – the influence of the sample matrix or sample components upon the ability to qualitatively identify or quantitatively measure compounds in environmental samples.

Matrix Spike (MS) – an aliquot of a sample that is spiked with a known amount of target analyte(s) for which an independent estimate of target analyte concentration is available. Recovery of the matrix spike, expressed as percent recovery, is used to assess the bias of a method in a given sample matrix.

Matrix Spike Duplicate (MSD) – an aliquot of the same sample used for the MS, spiked with the identical amount(s) of target analyte(s) as the MS. Results of the two spikes are used to assess both the bias and precision of a method with a given sample matrix.

May – denotes permitted action, but not required action

Method of Standard Addition (MSA) – a method in which small increments of a substance under measurement are added to a sample to establish a response function, and by extrapolation, to determine the amount of the substance originally present in the sample.

Must – denotes a requirement that has to be met

Narrative – portion of the data package which includes laboratory, contract, case and sample number identifications, and descriptive documentation of any problems encountered in processing the samples along with corrective action taken and problem resolution.

National Environmental Laboratory Accreditation Conference (NELAC) – a voluntary organization of State and Federal environmental officials and interest groups purposed primarily to establish mutually acceptable standards for accrediting environmental laboratories. A subset of NELAP.

National Environmental Laboratory Accreditation Program (NELAP) – the overall National Environmental laboratory Accreditation Program of which NELAC is a part.

Negative Control – measures taken to ensure that a test, its components, or the environment do not cause undesired effects, or produce incorrect test results.

Percent Difference (%D) – used to compare two values, the percent difference indicates both the direction and the magnitude of the comparison. The percent difference may be either negative, positive, or zero. (In contrast, see relative percent difference.)

$$\%D = \frac{(X - Y)}{X} * 100$$

where: X = value 1
Y = value 2

Percent Recovery – a measure of accuracy that is calculated as the measured value relative to the true value, expressed as a percent.

$$\%R = \frac{MV}{TV} * 100$$

where: MV = measured value
TV = true value

Performance Audit – the routine comparison of independently obtained qualitative and quantitative measurement system data with routinely obtained data in order to evaluate the proficiency of an analyst or laboratory.

Post Digestion Spike – the addition of a known amount of standard after digestion

Positive Control – measures taken to ensure that a test and/or its components are working properly and producing correct or expected results from positive test subjects

Precision – the degree of mutual agreement characteristic of independent measurements as the result of repeated application of the process under specified conditions. It is concerned with the comparability of results from duplicate or replicate analyses. (%RPD between the recoveries of two known analyte spikes, and %RSD between the recoveries of three or more measurements).

Preservative – a reagent added to a sample, or an action used, to prevent or slow decomposition or degradation of a target analyte or a physical process. Thermal and chemical preservation may be used in tandem to prevent analyte deterioration.

Procedure – specified way to carry out an activity or a process

Proficiency Testing – a means of evaluating a laboratory's performance under controlled conditions relative to a given set of criteria through analysis of unknown samples provided by an external source

Proficiency Test Sample – a sample, the composition of which is unknown to the analyst and is provided to test whether the analyst/laboratory can produce analytical results within specified acceptance criteria

Protocol – a detailed written procedure for field and/or laboratory operation (e.g., sampling, analysis) which must be strictly followed

Quality Assurance – an integrated system of activities involving planning, quality control, quality assessment, reporting and quality improvement to ensure that a product or service meets defined standards of quality with a stated level of confidence

Quality Assurance Plan – a document stating the management policies, objectives, principles, organizational structure and authority, responsibilities, accountability, and implementation of an agency, organization, or laboratory, to ensure the quality of its product and the utility of its product to its users

Quality Control – the overall system of technical activities whose purpose is to measure and control the quality of a product or service so that it meets the needs of users

Quality System – a structured and documented management system describing the policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an organization for ensuring quality in its work processes, products (items), and services. The quality system provides the framework for planning implementing, and assessing work performed by the organization and for carrying out required QA and QC.

Raw Data – any original factual information from a measurement activity or study recorded in a laboratory notebook, worksheets, records, memoranda, notes, or exact copies thereof that are necessary for the reconstruction and evaluation of the report of the activity or study.

Relative Percent Difference (% RPD) – used to compare two values, the relative percent difference is based on the mean of the two values, and is reported as an absolute value, i.e., always expressed as a positive number or zero. (In contrast, see percent difference.)

$$\% \text{ RPD} = \frac{|X - Y|}{(X + Y) / 2} * 100$$

where: X = value 1

Y = value 2

Relative Response Factor – a measure of the relative response of an analyte compared to that of its internal standard. Relative response factors (RRF) are determined by analysis of calibration standards and are used in the quantitation of target analytes in samples. RRF is calculated as follows:

$$\text{RRF} = \frac{Ax \times Cis}{Ais \times Cx}$$

where:

Ax = area of the compound of interest measured

Cis = concentration of the internal standard

Ais = area of the internal standard

Cx = concentration of the analyte of interest

Relative Retention Time (RRT) – the ratio of the retention time of a compound to that of a standard (such as an internal standard).

$$RRT = \frac{RT_c}{RT_{is}}$$

where:

RT_c = Retention time for the target analyte or surrogate in continuing calibration.

RT_{is} = Retention time for the internal standard in calibration standard or in a sample.

Replicate Analyses – the measurements of the variable of interest performed identically on two or more sub-samples of the same sample within a short time

Requirement – denotes a mandatory specification; often designated by the term "shall"

Retention Time – the time elapsed from sample injection on a gas or ion chromatograph until the specific compound elutes or exits the chromatographic column at the detector. Each analyte has a characteristic retention time on a specific column allowing this information is used to qualitatively identify the analytes in the sample.

Sample – a portion of material supplied by the client for analysis.

Sample Delivery Group (SDG) – a unit within a single project that is used to identify a group of samples for delivery. A SDG is a group of 20 or fewer field samples within a project, received over a project-specified period of time. Data from all samples in a SDG are due concurrently.

Shall – denotes a requirement that is mandatory whenever the criterion for conformance with the specification requires that there be no deviation. This does not prohibit the use of alternative approaches or methods for implementing the specification so long as the requirement is fulfilled

Should – denotes a guideline or recommendation whenever noncompliance with the specification is permissible

Standard Operating Procedure (SOP) – a written document which details a procedure adopted for repetitive use when performing a specific measurement or task. It may be a standard method or one developed by the client or laboratory.

Surrogate Compound – compound that behaves similarly, with respect to the analytical method, as the analytes of interest but is not normally found in environmental samples. Often, surrogates are isotopic homologues of target analytes. Surrogate(s) are added to all blanks, samples and QC samples prior to preparation and analysis. Recovery of surrogates is used to assess method performance.

Validation – the confirmation by examination and provision of objective evidence that the particular requirements for a specific intended use are fulfilled

Verification – confirmation by examination and provision of evidence that specified requirements have been met

Working range – the difference between the Limit of Quantitation and the upper limit of measurement system calibration

ACRONYMS

AA	Atomic Absorption Spectrometer
AFCEE	Air Force Center for Environmental Excellence
ASTM	American Society for Testing and Materials
BFB	Bromofluorobenzene
BOD	Biological Oxygen Demand
BTEX	Benzene, Toluene, Ethylbenzene, Xylenes
CCC	Calibration Check Compounds
CCV	Continuing Calibration Verification
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act (1980)
CFR	Code of Federal Regulations
CLP	Contract Laboratory Program
COC	Chain-of-Custody
COD	Chemical Oxygen Demand
CRDL	Contract Required Detection Limit
CVAA	Cold Vapor Atomic Absorption
CWA	Clean Water Act
DFTPP	Decafluorotriphenyl phosphine
DO	Dissolved Oxygen
DQO	Data Quality Objectives
DRO	Diesel Range Organics
ECD	Electron Capture Detector
EDB	Ethylene Dibromide
EPA	Environmental Protection Agency
FID	Flame Ionization Detector
GALP	Good Automated Laboratory Practices
GC	Gas Chromatograph
GC/MS	Gas Chromatograph/Mass Spectrometer
GFAA	Graphite Furnace Atomic Absorption
GLP	Good Laboratory Practices
GRO	Gasoline Range Organics
HAZMAT	Hazardous Materials
HPLC	High Performance Liquid Chromatography
HVAC	Heat, Ventilation and Air Conditioning System
ICP	Inductively Coupled Plasma Spectrometry
ICPMS	Inductively Coupled Plasma Mass Spectrometry
ICS	Interference Check Standard
ICV	Initial Calibration Verification
IDC	Initial Demonstration of Capability
IDL	Instrument Detection Limit
ISO	International organization for Standardization
ISTD	Internal Standard
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
LDR	Linear Dynamic Range
LFB	Laboratory Fortified Blank
LFM	Laboratory Fortified Matrix
LIMS	Laboratory Information Management System
LOD	Limit of Detection
LRB	Laboratory Reagent Blank
LUST	Leaking Underground Storage Tank
MB	Method Blank
MBAS	Methylene Blue Active Substances
MCL	Maximum Contaminant Level
MDL	Method Detection Limit
mg/Kg	Milligrams per kilogram
mg/L	Milligrams per liter
MQL	Method Quantitation limit
MRL	Method Reporting Limit
MS	Matrix Spike
MSA	Method of Standard Addition
MSD	Matrix Spike Duplicate
MTBE	Methyl Tertiary Butyl Ether
NIOSH	National Institute of Occupational Safety and Health
NIST	National Institute of Standards and Technology
NPDES	National Pollutant Discharge Elimination System
NTU	Nephlometric Turbidity Unit
PAH	Polynuclear Aromatic hydrocarbons
PCB	Polychlorinated Biphenyl
PID	Photo Ionization Detector
PNA	Polynuclear Aromatics
ppb	Parts per Billion
ppm	Parts per Million
ppt	Parts per Trillion
ppth	Parts per Thousand
PQL	Practical Quantitation Limit
PVOC	Petroleum Volatile Organic Compounds
QA	Quality Assurance
QAP	Quality Assurance Plan
QC	Quality Control
RCRA	Resource Conservation and Recovery Act
RDL	Reportable Detection Limit
RF	Response Factor
RPD	Relative Percent Difference
RRF	Relative Response Factor
RRT	Relative Retention Time
RSD	Relative Standard Deviation
SARA	Superfund Amendments and Reauthorization Act of 1986
SDG	Sample Delivery Group
SDWA	Safe Drinking Water Act
SOC	Synthetic Organic Chemicals
SOP	Standard Operating Procedure
SOW	Statement of Work
SPCC	System Performance Check Compounds
SPLP	Synthetic Precipitation Leaching Procedure
SW-846	Test Methods for Evaluating Solid Waste
TCLP	Toxicity Characteristic Leaching Procedure
TDS	Total Dissolved Solids
TOC	Total Organic Carbon
TOX	Total Organic halides
TRPH	Total Recoverable Petroleum Hydrocarbons
TSS	Total Suspended Solids
THMs	Trihalomethanes
TTHM	Total Trihalomethanes
ug/Kg	Micrograms per kilogram
ug/L	Micrograms per Liter
USACE	U S Army Corps of Engineers
UV/Vis	Ultraviolet/Visible wavelength
VOC	Volatile Organic Compound
WET	Whole Effluent Toxicity test
WG	Work Group
ZHE	Zero Headspace Extractor

Appendix C - Standard Operating Procedure List

APPENDIX C

PDC Laboratories, Inc. - St. Louis

Organic Department SOPs

Description	**NELAC**	**Method**	**SOP #**
Chlorinated Pesticides	*	SW 8081A	SOP #300SL_ORG-608(2)
Chlorinated Pesticides/PCBs	*	E 608	SOP #300SL_ORG-8081A(2)
Semi-Volatile Organic Compounds	*	SW 8270C; E 625	SOP #300SL_ORG-8270-625()
Volatile Organics	*	SW 8260B; E 624	SOP #300SL_ORG-8260-624()
Separatory Funnel Liquid –Liquid Extraction – Semi-Volatiles	*	E 625; SW 8270C – 3510C	STL-SOP-ORG-PREP-8270_3510(1.2)
Ultrasonic Extraction – Semi-Volatiles	*	SW 8270C – 3550C	STL-SOP-ORG-PREP-8270_3550(2.2)
TCLP Leachate Generation-ZHE	*	SW 1311	STL-SOP-ORG-ZHE(1.0)
Toxicity Characteristic Leaching Procedure (TCLP) – Bottle	*	SW 1311	STL-SOP-TM-TCLP1311(1.0)
Separatory Funnel Liquid-Liquid Extraction of Diesel Range Organics		SW 8015 – 3510C; Iowa OA-2	SOP-ORG-PREP-DRO_H2O(2)
Ultrasonic Extraction of Diesel Range Organics		SW 8015 – 3550C; Iowa OA-2	SOP-ORG-PREP-DRO_SOIL(2)
Non-Halogenated Organics		SW 8015 B	SOP-ORG-8015B(4)
Separatory Funnel Liquid-Liquid Extraction – PCBs & Pesticides		E 608; SW 8081A, 8082, 8141A – 3510C	SOP-ORG-PREP-8081-8082-8141_608(2)
Ultrasonic Extraction – PCBs & Pesticides		SW 8081A, 8082, 8141A – 3550C	SOP-ORG-PREP-8081-8082-8141_3550(2)
Polychlorinated Biphenyls		SW 8082	SOP #300SL_ORG-8082(2)
Polychlorinated Biphenyls - Wipes – Ultrasonic Extraction		SW 8082 – 3550C	SOP-ORG-PREP-8082-WIPE(2)
Continuous Liquid-Liquid Extraction – Semi-Volatiles		E 625; SW 8270C – 3520C	SOP-ORG-PREP-8270_625_3520(1)
Continuous Liquid-Liquid Extraction – Semi-Volatiles		E CLP OLC02.1	SOP-ORG-PREP-OLC021_BNA(0)
Separatory Funnel Liquid –Liquid Extraction – PNAs		E 610; SW 8310 – 3510C	SOP-ORG-PREP-8310_610(2)
Soxhlet Continuous Liquid-Liquid Extraction – PNAs		SW 8310 – 3540C	SOP-ORG-PREP-8310_3540(2)
Ultrasonic Extraction – PNAs		SW 8310 – 3550C	SOP-ORG-PREP-8310_3550(1.1)
Polynuclear Aromatic Hydrocarbons		SW 8310; E 610	SOP-ORG-8310-610(7)
Pesticide/PCB Clean-Up		SW 3660B/3665A	SOP-ORG-CLEANUP(2)
Preparation & Documentation of Standards		NA	SOP-ORG-STDDOC(1)
Determination of Volatile Petroleum Hydrocarbons (Gasoline)		Iowa OA-1	SOP-ORG-OA1(3)
Determination of Total Extractable Hydrocarbons		Iowa OA-2	SOP-ORG-OA2(3)
Operation & Maintenance – TEKMAR Ultrasonic Processor		NA	SOP-GENERAL-TekSonic(0)
Organic Department Nomenclature		NA	SOP-ORG-NOMENCLATURE(0)
Extraction of Alachor from Water		Monsanto Ag	410-019
Extraction of PCBs from Paperboard		JAOAC (V56, N4, 1973)	410-004

PDC Laboratories, Inc. - St. Louis

Metals Department SOPS

Description	NELAC	Method	SOP #
Inductively Coupled Plasma (VARIAN)	*	E 200.7	SOP #301SL_MTL_200.7(3)
Inductively Coupled Plasma (VARIAN)	*	SW 6010B	SOP #301SL_MTL-6010B(3)
Mercury	*	E 245.1	SOP #301_MTL-245.2()
Mercury	*	SW 7470A; 7471A	SOP #301_MTL-7470/7471(3)
Hot Block (Sample Digestion)		E 200.2	SOP-METALS-200.2(1)
Toxicity Characteristic Leaching Procedure (TCLP) – Trace Metals	*	SW 1311	STL-SOP-TM-TCLP1311(1.0)
Synthetic Precipitation Leaching Procedure (SPLP) – Trace Metals Synthetic Precipitation Leaching Procedure (SPLP) – Trace Metals		SW 1312	SOP-TM-SPLP(2)
Multiple Extraction Procedure		SW 1320	SOP-TM-1320MEP(1)
Turbidity		E 180.1	SOP-METALS-Turb(5.1)
Filtration for Dissolved Metals		SM 3030B	SOP-METALS-FiltrDisSolids(1)
Shake Extraction of Solid Waste with Water		ASTM D3987-85	SOP-TM-SHAKEXT(0)
Acid Digestion of Waters for Total Recoverable or Dissolved Metals		SW 3005A	320-3005A
Acid Digestion of Aqueous Samples & Extracts for Total Metals		SW 3010A	320-3010A
Acid Digestion of Sediments, Sludges & Soils		SW 3050A	320-3050A

PDC Laboratories, Inc. - St. Louis

Inorganics Department SOPS

Description	**NELAC**	**Method**	**SOP #**
Acidity		SM 2310B	SOP #301SL_WC-ACIDITY(2)
Alkalinity		SM 2320B	SOP #301SL_WC-ALKALINITY(2)
Ammonia – Nitrogen	*	SM 4500 NH3 B/F	SOP #301SL_WC-AMMONIA(4)
Biochemical Oxygen Demand (BOD and cBOD)	*	E 405.1; SM 5210B	SOP #301SL_WC-BOD5(3)
Bulk Density		ASTM E1109	SOP-INORG-BULKDENSITY(3)
Calcium Carbonate Equivalent (Methods of Soils Analysis)		Methods of Soils Analysis 91-4	SOP-INORG-CCE(7)
Chloride		SM 4500-Cl C; SW 9251	STL SOP - Chloride
Chlorine		SM 4500Cl-G	SOP-INORG-CHLORINE(2.1)
Reactive Cyanide (including SW-846 Chapter 7 – 7.3.3.2)		SW 9010B/9012; SM 4500 CN C	310-103
Total Cyanide	*	SW 9010B/9014, SM 4500 CN C	SOP #301SL_WC-CYANIDE, TOTAL (2)
Cyanide Amenable to Chlorination		SM 4500-CN C, G; SW 9010B/9012A	310-035
Weak Acid Dissociable Cyanide		SM 4500-CN I	310-038
Chemical Oxygen Demand	*	SM 5220D; HACH Method 8000	SOP #301SL_WC-COD(2)
Color		SM 2120B	SOP-INORG-COLORVISUAL(5.1)
Density		SM 2710F	SOP-INORG-DENSITY(1.1)
Flash Point (Open cup)		ASTM D 1310-86	SOP-INORG-FPOPEN(5.1)
Flash Point (Closed Cup)		SW 1010; ASTM D 93-80	SOP-INORG-FPCLOSED(4)
Flash Point (Tag Tester)		SW 1020A; ASTM D 56	310-1020
Fluoride		SM 4500-F C	STL SOP 340.2 – Fluoride(1)
Glassware Cleaning		NA	300-002
Total Hardness		SM 2340C	310-1302
n-Hexane Extractable Material	*	E 1664A	SOP #301SL_WC-HEMSPE(2)
n-Hexane Extractable Material		SW 9071B	STL SOP-INORG-HEM9071B(3.1)
Hexavalent Chromium		SW 7196A/3060A; SM 3500Cr D	SOP-INORG-HEXCHR(6.4)
Inorganic Anions by Ion Chromatography	*	E 300.0; SW 9056	SO #301SL_WC–IC(3)
Ignitability	*	SW 1020	SOP #301SL_WC-Ignitibility(2)
Loss on Ignition		ASTM D2795-84 Modified	SOP-INORG-LOI(5)
MBAS Surfactants		SM 5540C	310-4251
Nitrate and Nitrite		SM 4500-NO3 F	SOP #301SL_WC-Nitrate/Nitrite(2)
Oil & Grease (HEM)		E 1664A	STL-SOP HEM(1.2)
Orthophosphate		SM 4500P E	STL-SOP Phosphorus
Paint Filter	*	SW 9095B	SOP #301SL_WC-Paintfltr3)
pH	*	SW 9040B; SW 9045C	STL-SOP-PH(1)
Total Phenolics	*	E 420.1; SW 9065	SOP #301SL_WC-PHENOLICS(2)
Phosphorus – Total	*	SM 4500-P B, F	SO #301SL_WC-PHOSPHORUS (2)
Reactive Sulfide		SW 9034/SW 7.3.4.1	STL SOP 9034 - RSULFIDE(1)
Reactivity to Water		SW 7.3.2.1	SOP-INORG-REACTTOH2O(1.1)
Settleable Solids		SM 2540F	310-1605
Specific Oxygen Uptake Rate (SOUR)		E 1683; SM 2710B	SOP-INORG-S.O.U.R(1.0)
Specific Conductivity and Resistivity		SM 2510B	SOP-INORG-SpCd(2)
Conductivity		E 120.1	STL SOP 2520B – Conductivity(1)

Specific Gravity		SM 2710F	310-116
Sulfate – Gravimetric		SM 4500SO4 E	310-3754
Total Disolved Solids		SM 2540C	SOP #301SL_WC-TDS(2)
Total Kjeldahl Nitrogen		SM 4500Norg B, H	STL SOP-INORG-TKN (1)
Total Suspended Solids	*	SM 2540D	SOP #301SL_WC-SS(2)
Total Solids		SM 2540B	SOP #301SL_WC-TS(2)
Total Sulfide		SM 4500 S E	STL SOP – Tsulfide(1)
% TVS / TVDS / TVSS, Volatile and Fixed Solids		E 160.4	310-1604

PDC Laboratories, Inc. – St. Louis

General SOPs

Description	NELAC	Method	SOP #
Bottle Cleaning		NA	STL-SOP-GEN-BotPrep(2)
Bottle QC		NA	SOP-GEN-BotQC(2)
Calibration of Hamilton Style Syringes	*	NA	SOP-GEN-Ham SyringeCal(1)
Calibration of Non-Contact Thermometers	*	NA	STL-SOP-GEN-TempGun Cal(1.1)
Calibration of Thermometers	*	NA	STL-SOP-GEN-ThermCal(1.1)
Chromatographic Peak Integration Procedures	*	NA	SOP-GEN-ManInteg(1.1)
Client Complaint Resolution	*	NA	SOP-GEN-CmplRes(0)
Client Confidentiality	*	NA	STL-SOP-GEN-ClientConfident
Compositing, Size Reduction and Subsampling	*	NA	SOP-GEN-CompRedSubsmp(1)
Contract Review and New Projects	*	NA	SOP-GEN-ContRvw(2)
Creating a New Product in SeedPak		NA	SOP-GEN-LIMS_Product-Lims(1)
Creating SeedPak Quotes		NA	SOP-GEN-Creating Seedpak Quotes(1)
Creating Standard/Pkey Reporting Lists		NA	SOP-GEN-LIMS_Prod-Lists(1)
Easy Pure Water Treatment System Operation and Maintenance	*	NA	STL SOP-GEN-EasyPure(1)
Email Use		NA	SOP-GEN-LIMS_Email(0)
Employee Identification Register(Signature List)	*	NA	STL SOP-GEN-EmpIdSig(1.1)
Estimation of Measurement Uncertainty	*	NA	SOP-GEN-EstMeasUncert(0)
Field Sampling Procedures		NA	STL-SOP-FieldSample(1)
File Scanning		NA	SOP-GEN-FileScanning(1)
Guidelines for MDL Studies & IDC	*	NA	SOP-GEN-MDL/IDC(1)
Handling Overdue Accounts		NA	SOP-GEN-Ovrduacct(1)
Instrument Lock-Out Tag-Out	*	NA	STL SOP-GEN-LockOutTagOut(1.2)
Laboratory Information Management Data Edit		NA	SOP-GEN-LIMS_DataEdit(1)
Laboratory Information Management Data Entry		NA	SOP-GEN-LIMS_ManDataEntry(1)
Laboratory Information Management Electronic Data Entry		NA	SOP-GEN-LIMS_ElectDataEntry(1)
LIMS Data Backup		NA	SOP-GEN-LIMS_Backup(1)
Login Summary Report Generation		NA	STL SOP-GEN-LoginSumRpt(2)
Monitoring Fume Hoods		NA	SOP-GEN-FumeHood(1)
Pipet Checks		NA	STL-SOP-GENERAL-Pipet Cal(1)
Proficiency Testing (PT) Sample Login	*	NA	SOP-GEN-PTLogin(1)
Quality System Review Procedure	*	NA	SOP-GEN-QASysRvw(1)
Quarterly/Monthly QC Program Login		NA	SOP-GEN-Qtr/MoQCPLogin(1)
Quarterly/Monthly QC Sample Preparation		NA	SOP-GEN-Q_MQCPrep(0)
Record Transfer Procedure		NA	SOP-GEN-RcrdTrnsfr(2.1)
Sample Disposal		NA	SOP-GEN-SmpDisposal(2)
Sample Storage Quality Control		NA	SOP-GEN-Samp StorgQC(2)
Scheduling Work/Creating Work Groups		NA	SOP-GEN-LIMS_WG(1)
Server Backup		NA	STL-SOP-GEN_ServerBackup(1)
Standard Operating Procedures	*	NA	SOP-GEN-SOP(0)
Subcontracting	*	NA	SOP-GEN-Subcon(3)
Definitions		NA	STL-SOP-GEN_Definitions
Rounding Off Numbers		NA	STL-SOP-GEN_Rounding
Control Charts		NA	STL-SOP-GEN_Cntrlchart

Calibration and Maintenance of Analytical Balances	*	NA	000-150
Using Quality Improvement Reports (CA)	*	NA	STL-SOP-GEN QIR(2)
Performing Internal Audits	*	NA	STL-SOP-GEN IntAudit
Employee Training Summary (Manual)	*	NA	STL-SOP-GEN_EmplTrain
Recording & Documenting Standards & their Preparation	*	NA	STL SOP 100.020 – STD LOG(1)
Standard Laboratory Reporting Requirements	*	NA	STL SOP 100.300 – Reporting(1)
Cleaning Glassware in the Inorganic or Organic Laboratories		NA	STL SOP 100.350 – Glassware(1)
Maintenance of Chromatography Equipment		NA	STL SOP 100.500 – Equip. Maintenance
Deionized Water Quality Control		NA	STL-SOP DI WaterQual
Sample Receipt (Login)	*	NA	STL-SOP–SampleReceipt(2.2)
Sample Storage	*	NA	STL-SOP-SampleStorage(2.1)
Sub-Sampling	*	NA	STL-SOP-SubSampling(2.1)

Appendix D - Internally Prepared Bottle QC Requirements

PDC Laboratories, Inc. - St. Louis

Appendix D

INTERNALLY PREPARED BOTTLE QC REQUIREMENTS					
TYPE	**SIZE**	**PRESERVATIVE**	**AMOUNT**	**QC ANALYSES**	**ACCEPTANCE CRITERIA**
Ammonia	16 oz. NM plastic	H_2SO_4	Received from Supplier	NH_3	< RDL
Cyanide	16 oz. WM plastic	NaOH	Received from Supplier	CN –Total	< RDL
Shippers	32 oz. WM plastic	Unpreserved	-------	TOC, Specific Conductivity	<RDL for TOC, <5 umhos/cm for Spec. Cond.
Grease & Oil	32 oz. WM glass	HCl	2 ml conc acid	HEM	< RDL
Phenol	16 oz. NM amber glass	H_2SO_4	1 ml conc acid	Phenol	< RDL
TOX	16 oz. NM amber glass	H_2SO_4	1 ml conc acid	TOX	< RDL
Metals	16 oz. NM plastic and 32 oz NM plastic	HNO_3	Received from Supplier	Al, As, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, Hg, K, Mg, Mn, Na, Ni, Pb, Sb, Se, Tl, Zn	< RDL for all but Ca, K, Mg, Na which must be <0.1 mg/L each
Organics	½ gal amber	Unpreserved	-------	Organochlorine and Organophosphorus Pesticides, BNAs	< RDL

Appendix E - Chain-of-Custody, Sample Acceptance Policy & Cooler Receipt Form

PDC Laboratories, Inc. – St. Louis
3278 N. Highway 67 (Lindbergh)
Florissant, MO 63033
www.pdclab.com www.environmetrics.net

CHAIN OF CUSTODY RECORD

Phone (314) 432-0550 or (314) 921-4488
Fax (314) 432-4977 or (314) 921-4494

State where samples collected________

(Instructions/Sample Acceptance Policy on Reverse)

ALL SHADED AREAS MUST BE COMPLETED BY CLIENT (PLEASE PRINT)

1 CLIENT	PROJECT NUMBER	P.O. NUMBER	MEANS SHIPPED	3 ANALYSIS REQUESTED	4 (FOR LAB USE ONLY)
ADDRESS	PHONE NUMBER	FAX NUMBER	EMAIL ADDRESS		LOGIN # ______________
CITY STATE ZIP	SAMPLER		MATRIX TYPES: WW-WASTEWATER DW DRINKING WATER GW-GROUND WATER WWSL-SLUDGE NAS-SOLID LCHT-LEACHATE NAL NONAQUEOUS LIQUID SOIL-SOILS		LOGGED BY:__________ LAB PROJ # TEMPLATE:
CONTACT PERSON	SAMPLER'S SIGNATURE				PROJ. MGR:

2 SAMPLE DESCRIPTION AS YOU WANT ON REPORT	DATE COLLECTED	TIME COLLECTED	SAMPLE TYPE GRAB	COMP	MATRIX TYPE	Bottle Count								REMARKS

5 TURNAROUND TIME (RUSH TAT IS SUBJECT TO PDC LABS APROVAL AND SURCHARGE)

☐ Normal (8-10 Bus. Days) ☐ Rush (5 Bus. Days) ☐ *Fastrak*$_{TM}$ (3 Bus. Days) ☐ 1-2 Bus. Days ☐ Same Day

DATE DUE ____________________

RESULTS BY: ☐ E-MAIL ☐ FAX ☐ PHONE CALL PHONE/FAX # IF DIFFERENT FROM ABOVE

6 The sample temperature will be measured upon receipt at the lab. By initialing this area, you request that the lab notify you, before proceeding with analysis, if the sample temperature is outside of the range of 0.1-6.0°C. By not initialing this area, you allow the lab to proceed with analytical testing regardless of the sample temperature. ________________

7 RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY:	DATE	TIME
RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY:	DATE	TIME
RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY:	DATE	TIME
RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY:	DATE	TIME

8 **COMMENTS: (FOR LAB USE ONLY)**

SAMPLE TEMPERATURE UPON RECEIPT	______ °C
CHILL PROCESS STARTED PRIOR TO RECEIPT	Y OR N
SAMPLE(S) RECEIVED ON ICE	Y OR N
PROPER BOTTLES RECEIVED IN GOOD CONDITION	Y OR N
BOTTLES FILLED WITH ADEQUATE VOLUME	Y OR N
SAMPLES RECEIVED WITHIN HOLD TIME(S) (EXCLUDES TYPICAL FIELD PARAMETERS)	Y OR N
DATE AND TIME TAKEN FROM SAMPLE BOTTLE	______

Thank you for using PDC Laboratories, Inc. Locations in Peoria, IL; St. Louis, MO; and Springfield, MO

PAGE OF

1 **CLIENT NAME**: Client's Company name
ADDRESS: Client's mailing address
CITY, STATE, ZIP: Client's City State and Zip Code for mailing
CONTACT PERSON: Person to receive results
PROJECT NUMBER: Client's reference to the project or work involved with these samples
P.O.NUMBER: Client's invoicing information
MEANS SHIPPED: UPS, Federal Express, Postal Service, courier, hand carried, etc.
PHONE NUMBER: Client's phone number (please include area code)
FAX NUMBER: Client's fax number (please include area code)
EMAIL: Email address of the person to receive results
SAMPLER: Name of sample collector
SAMPLER'S SIGNATURE: Signature of sample collector
STATE WHERE SAMPLES COLLECTED: Enter the state if different from client address

2 **SAMPLE DESCRIPTION**: The unique sample description you want to appear on the analytical report.
DATE COLLECTED: Date sample was collected. For composite samples, this is typically the date when the last aliquot was added.
TIME COLLECTED: Time sample was collected. For composite samples, this is typically the date when the last aliquot was added.
SAMPLE TYPE: Place an "X" in the box marked "GRAB" if the sample was collected at one time from one specific location. Place an "X" in the box marked "COMP" if the sample is a composite of samples collected at one or more times or locations, and combined to make one sample.
MATRIX TYPE: From the above this field. If "OTHER", please identify.
BOTTLE COUNT: Total number of containers submitted for the samples

3 **ANALYSIS REQUESTED**: Write the analysis name (or an abbreviation), the name of a group of tests, or the method number you would like us to perform. Examples are Suspended Solids, SS, TCLP Metals, 503 Sludge Regs, Method 8080, etc. Place an "X" in the small boxes that correspond to the sample(s) on which you want these tests performed.
REMARKS: List special instructions about the sample here. This space can also be used for listing additional analyses, or to request an extra copy of the report to be sent to an alternate person/address.

4 To be completed by laboratory personnel.

5 TURNAROUND TIME REQUESTED: Circle "NORMAL" if you want routine 10 working day TAT. If faster results are needed, circle the appropriate TAT and, if possible, call the lab in advance to schedule this work. Surcharges apply for expedited samples.
If you need both fast and normal TAT on the same project, please fill out a separate chain of custody for the expedited samples.

6 Place your initials on the line if you would like the lab to call you, before proceeding with analysis. If the temperature of you sample(s) is outside the 0.1-6.0°C range. Many of the analytical methods, compliance regulations, and lab accreditation rules require that the samples be kept within this range until analyzed. There are ways to help ensure that the samples remain cold during shipping. Contact your project manager for further information.

7 RELINQUISHED BY/RECEIVED BY: This form must be signed each time the sample(s) changes hands. Chain-of-Custody seals are available upon request, if needed.

8 To be completed by laboratory personnel.

<u>Sample Acceptance Policy for Chain of Custody –</u>

Under the national Environmental Laboratory Accreditation Program (NELAP) and other state programs, <u>PDC Laboratories MUST follow specific required procedures when accepting samples.</u> *Your* records of sample collection, handling and transport are an important part of *our* ability to *efficiently and effectively* meet these laboratory accreditation requirements.

Samples not meeting the accreditation requirements for proper containers, preservation, receipt temperature and documentation/labeling may not be accepted until the proper information is received and discrepancies resolved. CONTACT YOUR PROJECT MANAGER IF YOU REQUIRE ASSISTANCE.

Samples are accepted based upon receiving a completed chain of custody and purchase order. Purchase order not required if other documentation authorizing work is or has been provided. Work is performed under PDC Laboratories' Standard Terms, Conditions and Operating Procedures unless superceded by Specific contract documents.

1. It is recommended to use the sample bottles supplied by PDC Labs. This ensures that the proper bottle types and preservatives are used and adequate volume for analysis is provided. Sample containers should be filled to the neck of the container, with the exception of vials for VOC/VOA/THM and bottles for TOX analysis, which should be filled completely leaving zero headspace. Bottles should not be rinsed with sample, as this will remove any preservative in preserved bottles. The only exception to this is if the sample reacts with the preservative in the VOC/VOA/THM vial. As the collection of sample is your responsibility, it is recommended that you have and adhere to a Sampling Plan.
2. Many of the test methods, as well as EPA compliance programs, require samples are kept cool during the shipping process. Failure to do so may cause your results to be unacceptable to any applicable regulatory authorities. In an attempt to keep the sample temperature near 4°C, coolers should contain ice bags. Frozen freezer packs are less effective. It is recommended to pre-cool the samples in an ice bath prior to shipment. This makes the cooling in shipping more effective. The temperature of the samples will be measured upon receipt at the lab. If the temperature is not within the range of 0.1-6°C, and the client has requested notification, login procedures are stopped until direction is provided from the client. The project manager will contact the client to obtain this information. The project manager will document this contact and the information provided. Any required information not supplied by the client will be indicated in the final report package. Contact your project manager for additional information regarding how to attain this temperature range.
3. Samples should be shipped to the lab as soon as possible. This helps to meet the maximum allowable holding times that are part of each analytical method. If the allowable holding time is exceeded when samples arrive at the lab, login procedures are stopped until direction is provided from the client. The project manager will contact the client to obtain this information. The project manager must document this client contact, and the direction the client gives on the COC, or include other similar documentation in the report package. The attached "Sample Acceptance Policy Attestation Statement" may also be used.
4. Chain of Custody (COC) forms must accompany the samples. The purpose of the COC is to identify the sample. Samples must be labeled such that the samples/sample containers can be linked to the COC form. The following information must be included on the COC: client name and address, sample collector's name, purchase order number, sample description/location, date and time of collection, sample type, matrix, total number of containers, and the requested analysis. Any discrepancies, missing information, bottle damage, insufficient sample volume, etc. will be noted and the appropriate project manager notified. The project manager will contact the client to obtain the missing information or resolve discrepancies. The project manager will document this client contact, and the direction given by the client. Any information not ultimately supplied by the client will be noted in the final report package.

Thank you for using PDC Laboratories, Inc.
Please call (314) 432-0550 if you have any questions about completing this form.

PDC Laboratories, Inc. – Federal Services
SAMPLE RECEIPT FORM

All *No* responses are to be described in the *Details/Comments* Section.

Delivery Method: ☐ Drop Off ☐ Commerical Carrier (UPS, FEDEX, etc.) ☐ Laboratory Pick-Up

Project ______________________________ **Cooler** ______ of __________
Shipping Container # (PDC / Other): _________

Received (date time)______________________________ By: ______________
Opened (If different)______________________________ By: ______________

Preliminary Examination Checklist

Did the shipping container arrive with an air bill/shipping slip?..	YES NO NA
If YES, carrier name & air bill #:____________________________________	
(Place any shipping documentation in file folder)	
Were custody seals on the outside of the shipping container?..	YES NO*
If YES, a: Were the custody seals intact upon arrival?...	YES NO*
b: Enter the Seal Date and Name (enter "NA" if not available):____________________	
Was the Chain of Custody (COC) documentation provided with the shipment?......................	YES NO*
If YES, a: Was the COC fully executed in ink by the shipper?...	YES NO*
b: COC #:	
c: Was the project identifiable from the COC?...	YES NO*
If No, how was this determined?____________________________________	
d: Was the COC properly signed as received by the Laboratory...............................	YES NO*
What was the temperature in the Cooler?______ ° Deg C.	
Were samples received within criteria of 2-6° Deg C?...	YES NO*
(Processed Water/Wastewater are excluded from the temperature criteria)	
Did the cooler contain Ice?...	YES NO*

Sample Examination & Check-In Checklist

Were samples packaged in conformance to generally accepted practices?..............................	YES NO*
Did all sample containers arrive intact and sealed?...	YES NO*
Did all sample containers have secure and completed labels?..	YES NO*
If sample containers possessed tags, circle: Tags only Tags + Labels	
Were caps of individual bottles/vials free from tape and/or custody seals?............................	YES NO*
Did all labels and/or tags agree with COC?...	YES NO*
Were QC samples included?..	YES NO
Did pH checks confirm indicated preservations? (if applicable)...	YES NO NA
Did volumes, containers, & preservatives seem appropriate to indicate tests?........................	YES NO*
Were VOA vials (waters) free from bubbles? (if applicable)...	YES NO* NA

If any NO *, Proceed with Login (YES / NO) Project Manager:_____________ Date:_______

Details/Comments:

____
____
____

1

Appendix F - Equipment List & Preventative Maintenance Forms

PDC Laboratories, Inc. - St. Louis – Equipment List

Appendix F

DEPARTMENT	QUANTITY	INSTRUMENT
Trace Metals	1	Varian MPX Axial Inductively Coupled Plasma Spectrophotometer
	1	Varian SpectrAA 220FS Atomic Absorption Spectrophotometer with VGA-76 Hydride/Cold Vapor accessory
	2	Environmental Express Hot Blocks
Trace Organics	1	Agilent 7890/5975 Gas Chromatograph – Mass Spectrometer (GC-MS)
	1	Hewlett Packard/Agilent 5890A/5970 Gas Chromatograph – Mass Spectrometer (GC-MS)
	1	Varian 3900GC with 2100 Ion Trap Mass Spectrometer
	1	Varian 3800GC with 2200 Ion Trap Mass Spectrometer
	1	Hewlett Packard 5890A Gas Chromatograph with dual Electron Capture Detectors (ECD)
	1	Varian 3400GC with ECD Detector
	1	Varian 3800GC with FID Detector
	1	Gilson Gradient 306 High Performance Liquid Chromatograph (HPLC) systems with 116 UV/Vis and 121Fluorescence Detectors and 231 Autosampler
	1	EST Encon Purge and Trap
	1	EST Centurion Autosampler
	1	Tekmar LSC 2000 Purge and Trap unit
	1	Varian-Archon Autosampler
	1	ABC Labs Model 1002B Gel Permeation Chromatography (GPC) units
	2	Dual Head Sonic Disrupters
	1	N-EVAP sample preparation unit
	6	Liquid-liquid Soxhlet extraction units
Inorganics	1	Horizon Technology SPE-DEX 3000XL Extractor System
	1	IEC Centra-4B Centrifuge
	1	Fisher Vortex Mixer
	1	Thermo Genesys 20 Spectrophotometer
	1	Shimadzu UV-1201 Spectrophotometer
	1	Hach DR/3000 Spectrophotometer
		Orion 720A pH/Conductivity/Ionanayzer
	1	Orion 920A pH/Conductivity/Ionanayzer
	1	Fisher-Tag Closed Cup Flashpoint Testers
	1	Fisher-Tag Cleveland Open Cup Flashpoint Tester
	1	Fisher-Tag Penske Martin Flashpoint Tester
	2	Setaflash Flashpoint Tester
	1	Parr Bomb Oxygen Calorimeter System
	1	Dionex DX-120 Ion Chromatograph

DEPARTMENT	QUANTITY	INSTRUMENT
	1	Dionex DX-320 Ion Chromatograph
	1	Hach COD Reactors
	2	Hach COD Colorimeter
	1	YSI Model 3560 Water Quality Monitor pH, Temperature, Conductivity Meter
	1	Labline Ambi HiLow BOD Incubator
	1	Fisher Model 3720 Isotemp BOD Incubator
	1	Fisher Model 307C BOD Incubator
	1	Hach HQ40d DO meter with LDO probe
	1	Orion 862A Advanced Dissolved Oxygen Meter with 086020A DO Probe
	1	Hach Ratio/XR Turbidimeter
	1	Thermolyne Model 62700 Furnace
	1	RephiLe Bioscience Direct-Pure Plus Ultrapure & RO Water System
	2	Fisher Model 655 Isotemp Ovens
	1	Fisher 307C Incubator
	1	VWR Scientific 2020 Dry Air Incubators
	1	Blue M 200A Dry Air Incubator
	1	Blue M SW 11TA Dry Air Incubator
	1	Precision FU 019ARW1 Dry Air Incubator
Microbiology		
	1	NAPCO Model 8000 DSE Autoclave
	1	IDEXX QTRAY 2000 Sealer
		365nm UV Viewing Cabinet
		Miscellaneous drying ovens
		Miscellaneous incubators
		Miscellaneous analytical and top-loading balances
		Water treatment system with softening, particulate removal, organics removal, ion removal.
General		

EXAMPLE

Preventative Maintenance Forms

ICP MAINTENANCE LOG

Instrument Type / ID: Varian Vista MPX Serial No.: EL0211 5724

Month / Year: ____________________

	Clean Air Filters **	Replace Air Filters ***	Vacuum Instrument Vents **	Clean Instrument **	Replace Sample Tubing *	Clean Torch *	Clean Nebulizer / Cyclone Chamber **	Check Water Level **	Change Water ***	Check Strainer **	Comments
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											
21											
22											
23											
24											
25											
26											
27											
28											
29											
30											
31											

* Perform Weekly
** Perform Monthly
*** Perform as Needed.

Read & Understood By: ___________________________ Date: ________________

CV Hg AA MAINTENANCE LOG

Instrument Type / ID: Varian SpectrAA-220FS Serial No.: __________

Month / Year: ____________________

	Tubing ***	Inspect Mixing Cell *	Clean Cell & Lenses *	Adjust Lamp ***		Replace Mixing Coil ***	Replace Lamp ***	Reductan Rinse & Waste Lines ***	Replace L/G Separator ***		Comments
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											
21											
22											
23											
24											
25											
26											
27											
28											
29											
30											
31											

* Perform Weekly
** Perform Monthly
*** Perform as Needed

Read & Understood By: ___________________________ Date: ______________________________

IC MAINTENANCE LOG

Instrument Type / ID: _Dionex________ Serial No.:

Month / Year: ___________________

	System Pressure	Total Conductivity ***	% Change in Retention	End-Line Filter ***	In-Line Filter ***	Guard Column ***	Analytical Column ***	Suppressor		Calibration ***	Service Call	Preventative Maintenance	Clean-up	Comments
1														
2														
3														
4														
5														
6														
7														
8														
9														
10														
11														
12														
13														
14														
15														
16														
17														
18														
19														
20														
21														
22														
23														
24														
25														
26														
27														
28														
29														
30														
31														

* Perform Weekly
** Perform Monthly
*** Perform as Needed.

Read & Understood By: _____________________________ Date: _______________

Organics Maintenance Log

Instrument Type/ID __________________
Month/Year ______________ / _______

	Replaced												Performed											
	Injection Port Liner	Injection Port Septum	Injection Liner O-ring	Injection Port Washer	Autosampler Syringe	Autosampler Needle	Transfer Line	Detector			Guard Column	Column*		CCV	Recalibrate	Cut Column		Cleaned Detector*	Check Head Pressure	Make-up Flow*	Purge Flow Check	Gas Flow Check*	Wipe Test	Comments**
1																								
2																								
3																								
4																								
5																								
6																								
7																								
8																								
9																								
10																								
11																								
12																								
13																								
14																								
15																								
16																								
17																								
18																								
19																								
20																								
21																								
22																								
23																								
24																								
25																								
26																								
27																								
28																								
29																								
30																								
31																								

* Requires additional information
** See reverse side for additional comments

Analyst: ____ Date: __________________

Read & Understood by: ____________________________________ Date: __________________

x:\environet\wp\sop\gcms\forms\maintenance log.xls

Organics Maintenance Log

Instrument Type/ID ________________

Month/Year ____________ / ______

	Replaced												Performed											
	Injection Port Liner	Injection Port Septum	Gold Seal	Autosampler Syringe	Injection Liner O-ring	Injection Port Washer	MS Source Parts*	Filament	Transfer Line	Trap*	Guard Column	Column*	Tune	CCV	Recalibrate	Cut Column	Check Head Pressure	Baked Trao	Cleaned Source*	Baked/Purged ALS Positions	Check MS Source Pressure	Purge Flow Check	Gas Flow Check*	Comments**
1																								
2																								
3																								
4																								
5																								
6																								
7																								
8																								
9																								
10																								
11																								
12																								
13																								
14																								
15																								
16																								
17																								
18																								
19																								
20																								
21																								
22																								
23																								
24																								
25																								
26																								
27																								
28																								
29																								
30																								
31																								

* Requires additional information
** See reverse side for additional comments

Analyst: ____ Date: ______________

Read & Understood by: ______________________________ Date: ______________

x:\environet\wp\sop\gcms\forms\gcms maintenance log.xls

Appendix G - Data Exception Report & Corrective Action Form

PDC Laboratories, Inc. – St. Louis

CORRECTIVE ACTION / QUALITY IMPROVEMENT REPORT

(EXTERNAL/INTERAL)

QIR Tracking Number: ______________________ SQI #: (See table on back) ______________

Company: ______________________ Client #: ______________

Contact: ______________________ Phone No. : ______________

Invoice #: ______________________ COC #: ______________

Lab # / Sample ID: ____

Dept/Person Initiating Form: ______________ Date: __________ Agreed Discharge Date: __________

Deficiency / Finding: ____

Establish the root cause of the (circle one) deficiency/finding: ______________________________

Corrective Action taken or proposed (circle one) to prevent deficiency/finding: ______________________

Corrective Action (to be) implemented by: ______________ Date corrective was or will be (circle one) implemented: ______________

Were any sample results affected: (circle one) Yes No Yes, list the sample numbers on back.

Actions taken to correct any affected data:

By Whom : ______________________ Date: ______________

Reviewed by: ______________________ Date: ______________

Verified by: ______________________ Date: ______________

PDC Laboratories, Inc. – St. Louis
CORRECTIVE ACTION / QUALITY IMPROVEMENT REPORT
(EXTERNAL/INTERAL)

Samples results affected:

Additional Comments:

SERVICE QUALITY INDICATORS (SQI)

1. Turnaround Time
2. Reporting Quality
3. Invoicing
4. Communication
5. Accuracy -Errors
6. Holding Times
7. Technical Support
8. Resolve Concerns
9. Met Client Expectations
10. Precision
11. Completeness: COC, Reports
12. Others

Appendix H - Laboratory Data Qualifiers

PDC LABORATORIES, INC.
DATA QUALIFIERS APPLICABLE TO THE “STANDARD QC” PROGRAM

A	The presence of this analyte was confirmed using a second column but there was a disparity (> 40% RPD) between the two sets of results with no apparent chromatographic anomalies. The lower of the two results was reported.
B	________ present in the method blank at _______.
B1	Blank contamination suspected and the sample result is less than the MRL.
B2	Contamination does not impact data since sample result is greater than 10 times the contamination level.
C	The blank spike failed to meet the required acceptance criteria.
D	Result obtained through analysis of a sample dilution.
E	Concentration exceeds the instrument calibration range.
F	Internal standard area failed to meet the required acceptance criteria in repeat instrumental analysis. Results should be interpreted as estimated concentrations.
G	The Method of Standard Additions (MSA) was used to quantify the concentration.
H	Test performed after the expiration of the appropriate regulatory/advisory maximum allowable hold time.
HS	Headspace present
J	Estimated value; value between the MDL and RDL.
K	Filter only – Not tumbled.
M	Analyte failed to meet the required acceptance criteria for duplicate analysis.
P	Present
Pc	Chemical preservation discrepancy noted at the time of analysis.
Pt	Thermal preservation discrepancy noted.
Q1	MS failed %R.
Q2	MSD failed %R.
Q3	MS/MSD both failed %R.
Q4	The matrix spike recovery is unusable since the analyte concentration in the sample is greater than four times the spike level. The associated blank spike was acceptable.
R	MS/MSD failed %RPD.
S	Surrogate compound diluted below a reliable quantitation level.
T	Surrogate recovery failed to meet the required acceptance criteria in initial analysis. Sample was re-extracted (if applicable and re-analyzed, and the surrogate recovery was outside of the required acceptance criteria on the second analysis.
U	Parameter was analyzed for, but not detected above the reporting limit.
V	Verification standard recovery failed to meet the required acceptance criteria on repeat instrumental analysis.
W	Surrogate recovery failed to meet the required acceptance criteria in initial analysis. Sample was re-extracted (if applicable) beyond the maximum allowable hold time, and re-analyzed.
NA	Not analyzed.
NR	Not requested.
X	Miscellaneous; see comments.

Appendix I - Initial Demonstration of Capability Certification Statement

PDC LABORATORIES, INC.
Initial Demonstration of Capability (IDC) Certification Statement

Date: x
Analyst: x

Matrix: Aqueous, Drinking Water, Non-aqueous Liquid, Solid
Method Number: method #, rev, analyte

We, the undersigned, CERTIFY that:

1. The analyst(s) identified above, using the cited test method(s), which is in use at this facility for the analyses of samples under the National Environmental Laboratory Accreditation Program, have met the Demonstration of Capability.

2. The test method(s) was performed by the analyst identified on this certification.

3. A copy of the test method(s) and laboratory-specific SOPs are available for all personnel on-site.

4. The data associated with the demonstration of capability are true, accurate, complete and self-explanatory (1).

5. All raw data (including a copy of this certification form) necessary to reconstruct and validate these analyses have been retained at the facility, and that the associated information is well organized and available for review by authorized assessors.

Department Manager's Name	Signature	Date
Quality Assurance Officer's Name	Signature	Date

(1)True: Consistent with supporting data
Accurate: Based on good laboratory practices consistent with sound scientific principles/practices.
Complete: Includes the results of all supporting performance testing.
Self-explanatory: Data properly labeled and stored so that the results are clear and require no additional explanation.

Appendix J - Example QC Checklists

PDC LABORATORIES, INC.

GC & HPLC QC Checklist

Work Group: Analysis Date:

Run ID: ____________ Batch: ______________ Analyst: ____________________

	N/A	Yes	No	---------------- "Exceptions" ---------------- Comments / Corrective Action
Have PEM (GC) and/or LPC criteria been met?				
Has CCV or ICAL passed criteria?				
Are the recoveries from the LCS acceptable?				
Does method blank meet method QC criteria?				
Are the surrogate recoveries acceptable?				
Are the ISTD recoveries acceptable?				
Are the CCVs within criteria?				
Has second column confirmation been performed for all positive identifications made in the primary analysis?				
Are all analyses free of interferences from previous analyses? If not, does the quality of the data remain unimpaired?				
Have all manual integrations been flagged with an M qualifier?				
Are dilution factors entered correctly?				
Batch checked for data entry errors?				

Note: Any "No" answer required a comment.

Additional comments: ________________________________

Completed By: ____________________ Reviewed By: ____________________

Date: ____________________ Date: ____________________

Reviewed By: ____________________ Reviewed By: ____________________

Date: ____________________ Date: ____________________

U:\QAQC\QCMasterForms\Chk2GCLC_1-05.doc

PDC LABORATORIES, INC.

GC/MS QC Checklist

Work Group:
Run ID: ____________ Analysis Date:
Batch: ____________ Analyst: ____________

	N/A	Yes	No	"Exceptions" Comments / Corrective Action
Have BFB (VOA) or DFTPP (SV) tuning criteria been met?				
Has CCV or ICAL passed criteria?				
Are the recoveries from the LCS acceptable?				
Does method blank meet method QC criteria?				
Are the surrogate recoveries acceptable?				
Are the ISTD recoveries acceptable?				
Are all analyses free of interferences from previous analyses? If not, does the quality of the data remain unimpaired?				
Have all manual integrations been flagged with an M qualifier?				
Are dilution factors entered correctly?				
Batch checked for data entry errors?				

Note: Any "No" answer required a comment.

Additional comments: ____________

Completed By: ____________
Date: ____________

Reviewed By: ____________
Date: ____________

Reviewed By: ____________
Date: ____________

Reviewed By: ____________
Date: ____________

U:\QAQC\QCMasterForms\Chk2GCMS_1-05.doc

PDC LABORATORIES, INC. - St. Louis

ICP-OES QC Checklist

Run Log ID: ___________________ Analysis Date: __________________ Analyst:________________________

(Reviewed for analytes of interest only.)

	N/A	Yes	No	-------------- "Exceptions" -------------- Coments / Corrective Action
Was calibration performed?				
Are the ICV and CCVs within criteria? If not, is an appropriate explanation provided?				
Is the method blank free of contamination?				
Are the recoveries from the lab control sample acceptable?				
Are all analyses free of interferences from previous analyses?				
Are dilution factors entered correctly?				
Are the MS/MSD recoveries within the acceptance limits? If not, are the samples appropriately flagged?				
Are the detection limits reported correctly?				
Are reported values consistent with the required units?				
Batch checked for data entry errors?				

Note: Any "No" answer requires a comment.

Additional comments or supplemental review:

PDC LABORATORIES, INC. - St. Louis

Mercury QC Checklist

Work Group: _______________ Analysis Date: __________________ Analyst:________________________

	N/A	Yes	No	--------------- "Exceptions" --------------- Coments / Corrective Action
Is the calibration acceptable (r>0.995)?				
Is the IPC acceptable (95-105%)				
Are the ICV and CCVs within criteria (90-110%)? If not, is an appropriate explanation provided?				
Are the ICB and CCBs within criteria (<RDL)? If not, is an appropriate explanation provided?				
Is the method blank free of contamination (<RDL)?				
Are the recoveries from the lab control sample acceptable (85-115%)?				
Are the MS/MSD recoveries within the acceptance limits (70-130%, RPD$\leq$20%)? If not, are the samples appropriately flagged?				
Are dilution factors entered correctly?				
Are the detection limits reported correctly?				
Are reported values consistent with the required units?				
Are all analyses free of interferences from previous analyses? If not, does the quality of the data remain unimpaired?				
Batch checked for data entry errors?				

Note: Any "No" answer required a comment.

Additional comments:

____

____

____

Completed By/Date: _____________________________

X:\Environet\WP\SOP\INORG\FORMS\Mercury QC Checklist.doc

PDC LABORATORIES, INC.

Inorganics QC Checklist

Workbook Page: ___________

Work Group: ________________ Analysis Date: ________________ Analyst: ________________

	N/A	Yes	No	"Exceptions" Comments / Corrective Action
Is the method blank free of contamination?				
Are the recoveries from the lab control sample acceptable?				
Are reported values consistent with the required units?				
Are the detection limits reported correctly?				
Are dilution factors entered correctly?				
Is the calibration curve correlation coefficient acceptable (r≥0.995)?				
Are the ICV and CCVs within criteria? If not, is an appropriate explanation provided?				
Are the MS/MSD recoveries within the acceptance limits? If not, are the samples appropriately flagged?				
Batch checked for data entry errors? (for electronic data transfer only)				

Note: Any "No" answer required a comment.

Additional comments: ________________

Completed By: ________________ Reviewed By: ________________
Date: ________________ Date: ________________

Reviewed By: ________________ Reviewed By: ________________
Date: ________________ Date: ________________

U:\QAQC\QCMasterForms\Chk2Inorg_1-05.doc

Appendix K -

TEST METHODOLOGIES and CERTIFICATIONS [1]

PARAMETER	NPDES Water	NELAC	RCRA Waste	NELAC
Acidity	305.1		---	
Alkalinity	310.1		---	
Aluminum	200.7	•	6010	•
Ammonia	4500NH_3-D&E	•	---	
Antimony	200.7	•	6010	•
Arsenic	200.7	•	6010	•
Barium	200.7	•	6010	•
Beryllium	200.7	•	6010	•
BOD5	5210B		405.1	
Boron	200.7		6010	•
Bromide	---		9056	
Cadmium	200.7	•	6010	•
Calcium	200.7	•	6010	•
CBOD5	405.1		405.1	
COD	5220C	•	410.4	
Cation exchange capacity	---		9080	
Chloride	325.3		9252/9056	
Chloride	300.0	•		
Chlorine, total residual	330.2		---	
Chromium	200.7	•	6010	•
Chromium, hex	218.8/200.7		7195/6010	
Cobalt	200.7	•	6010	•
Copper	200.7	•	6010	•
Cyanide, total	335.2		9010	•
Cyanide, amenable to chlorination	335.1		9010	
Cyanide, weak acid dissociable	4500CN I		---	
Fluoride	340.1		9056	
Fluoride	300.0	•		
Hardness	2340B		130.2	
PH	4500H-B		9040/9041/9045	•
Ignitability	---		1010/1020	
Iron	200.7	•	6010	•
Lead	200.7	•	6010	•
Magnesium	200.7	•	6010	•
Manganese	200.7	•	6010	•
Mercury	245.1	•	7470/7471	•

Molybdenum	200.7	•	6010	•
Nickel	200.7	•	6010	•
Nitrate	353.3	•	---	
Nitrate	300.0	•		
Nitrate/Nitrite	353.3		---	
Nitrite	353.3		---	
Nitrite	300.0	•		
Nitrogen, Kjeldahl	351.3		---	
Oil & Grease	1664A	•	9070/9071	
TOC	415.1		9060	
TOX	---		9020	
Orthophosphate	365.2		---	
Orthophosphate	300.0			
Oxygen, dissolved	360.1		---	
Paint filter	---		9095	•
Phenol	420.1		9065	•
Phosphate			9056	
Potassium	200.7	•	6010	•
Residue, total (TS)	2540B		2540B	
Residue, filterable (TDS)	2540C		2540C	
Residue, nonfilterable (TSS)	2540D	•	2540D	
Residue, settleable	2540F		2540F	
Residue, volatile	2540E		2540E	
Selenium	200.7	•	6010	•
Silicon	200.7		6010	
Silica	200.7		6010	
Silver	200.7	•	6010	•
Sodium	200.7	•	6010	•
Specific conductance	120.1		9050	
Strontium	200.7		6010	
Sulfate	375.4		9038/9056	
Sulfate	300.0	•		
Sulfide	376.2		9030	
Sulfite	377.1			
Surfactants	425.1			
Thallium	200.7	•	6010	•
Tin	200.7	•	6010	•
Titanium	200.7		6010	
Vanadium	200.7	•	6010	•
Zinc	200.7	•	6010	•
Volatile Organic Cpds	624	•	8260B	•
Volatile Aromatic Cpds (BTEX)	---		8060B	

Base/Neutrals & Acids	625	●	8270C	●
Pesticides (& PCBs)	608	●	8081A	●
Chlorophenoxy Herbicides			8150	
TTHM	---		---	
TCLP	---		1311	●
SPLP	---		1312	
Total Petroleum Hydrocarbons	1664A	●	418.1/8015	
Escherichia coli		☼	---	
Fecal coliform	9222D	☼	---	

1. For the most recent state-by-state listing of test methodologies and revisions for which PDC Laboratories, Inc. – St. Louis is accredited, contact client services.

This page is intentionally blank and is the last page of this document.

APPENDIX 2

Batch Log

Spent Blast Media Treatment and Disposal Work Plan
at
W&B of Franklin County
(formerly Missouri Green Materials, LLC)
7627 Zero Road, Berger, Missouri

Batch Log

Date: ____________________________

Batch Number: ____________________________

Package	Package ID	Net Weight (pounds)	Net Weight (tons)	Comments
	Total Net Weight			

Packaging: SS = Super Sack, D = Drum, C = Portland Cement, W = Water
Batch = 1 Blend, Lot = All Batches During One Day of Processing

APPENDIX 3

Daily Production Log

Spent Blast Media Treatment and Disposal Work Plan
at
W&B of Franklin County
(formerly Missouri Green Materials, LLC)
7627 Zero Road, Berger, Missouri

Daily Production Log

Production Date: ____________ Lot #: ______________________________________

Batch Number	Batch Weight (pounds)	Batch Weight (tons)	Comments
Daily Total Lot			

Batch = 1 Blend, Lot = All Batches During One Day of Processing

APPENDIX 4

TCLP Results Log

Spent Blast Media Treatment and Disposal Work Plan
at
W&B of Franklin County
(formerly Missouri Green Materials, LLC)
7627 Zero Road, Berger, Missouri

TCLP Results Log

Treated SBM Sample* ID	Lot Number	Sample Date	Cadmium mg/L	Chromium mg/L	Lead mg/L
		Average			

mg/L - milligram per liter
ND - Not detected above analytical reporting limits
* - Composite Grab Sample

Analytical Results Reviewed and Approved for Disposal:

US Technology: ______________________________

Gredell Engineering: ______________________________

EPA Region 7/MDNR-HWP: ______________________________

******Attach Analytical Results******

APPENDIX 5

Bill of Lading/
Shipping Manifest Example

Please print or type. (Form designed for use on elite (12-pitch) typewriter.)

Form Approved. OMB No. 2050-0039

UNIFORM HAZARDOUS WASTE MANIFEST

1. Generator ID Number	2. Page 1 of	3. Emergency Response Phone	**4. Manifest Tracking Number**

GENERATOR

5. Generator's Name and Mailing Address

Generator's Site Address (if different than mailing address)

Generator's Phone:

6. Transporter 1 Company Name — U.S. EPA ID Number

7. Transporter 2 Company Name — U.S. EPA ID Number

8. Designated Facility Name and Site Address — U.S. EPA ID Number

Facility's Phone:

9a. HM	9b. U.S. DOT Description (including Proper Shipping Name, Hazard Class, ID Number, and Packing Group (if any))	10. Containers No.	10. Containers Type	11. Total Quantity	12. Unit Wt./Vol.	13. Waste Codes
	1.					
	2.					
	3.					
	4.					

14. Special Handling Instructions and Additional Information

15. **GENERATOR'S/OFFEROR'S CERTIFICATION:** I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name, and are classified, packaged, marked and labeled/placarded, and are in all respects in proper condition for transport according to applicable international and national governmental regulations. If export shipment and I am the Primary Exporter, I certify that the contents of this consignment conform to the terms of the attached EPA Acknowledgment of Consent.
I certify that the waste minimization statement identified in 40 CFR 262.27(a) (if I am a large quantity generator) or (b) (if I am a small quantity generator) is true.

Generator's/Offeror's Printed/Typed Name — Signature — Month Day Year

INT'L

16. International Shipments ☐ Import to U.S. ☐ Export from U.S. Port of entry/exit: ____

Transporter signature (for exports only): Date leaving U.S.:

TRANSPORTER

17. Transporter Acknowledgment of Receipt of Materials

Transporter 1 Printed/Typed Name — Signature — Month Day Year

Transporter 2 Printed/Typed Name — Signature — Month Day Year

DESIGNATED FACILITY

18. Discrepancy

18a. Discrepancy Indication Space ☐ Quantity ☐ Type ☐ Residue ☐ Partial Rejection ☐ Full Rejection

Manifest Reference Number:

18b. Alternate Facility (or Generator) — U.S. EPA ID Number

Facility's Phone:

18c. Signature of Alternate Facility (or Generator) — Month Day Year

19. Hazardous Waste Report Management Method Codes (i.e., codes for hazardous waste treatment, disposal, and recycling systems)

1.	2.	3.	4.

20. Designated Facility Owner or Operator: Certification of receipt of hazardous materials covered by the manifest except as noted in Item 18a

Printed/Typed Name — Signature — Month Day Year

VOID

Please print or type. (Form designed for use on elite (12-pitch) typewriter.) Form Approved. OMB No. 2050-0039

GENERATOR

UNIFORM HAZARDOUS WASTE MANIFEST (Continuation Sheet)	21. Generator ID Number	22. Page	**23. Manifest Tracking Number**

24. Generator's Name

25. Transporter _______ Company Name | U.S. EPA ID Number

26. Transporter _______ Company Name | U.S. EPA ID Number

27a. HM	27b. U.S. DOT Description (including Proper Shipping Name, Hazard Class, ID Number, and Packing Group (if any))	28. Containers No.	28. Containers Type	29. Total Quantity	30. Unit Wt./Vol.	31. Waste Codes

VOID

32. Special Handling Instructions and Additional Information

TRANSPORTER

33. Transporter _______ Acknowledgment of Receipt of Materials

Printed/Typed Name | Signature | Month | Day | Year

34. Transporter _______ Acknowledgment of Receipt of Materials

Printed/Typed Name | Signature | Month | Day | Year

DESIGNATED FACILITY

35. Discrepancy

36. Hazardous Waste Report Management Method Codes (i.e., codes for hazardous waste treatment, disposal, and recycling systems)